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THE FUTURE OF CIVILIZATION

THE supreme need for concentrating national effort upon the successful prosecution of the war, and securing the overthrow of the forces which threaten good faith and understanding among the nations, should not be allowed to blind us to the necessity of preparing the foundations upon which a just and enduring peace can be based. It is, indeed, to defend the moral and spiritual realities upon which civilization itself depends that we have been driven to enter this conflict. To keep those moral issues clearly defined is essential if we are to sustain the sacrifices and effort which the task to which we have addressed ourselves will demand. We should not forget that it is possible to win a war and lose the peace.

There is, indeed, no reason for those who recognize that the future of civilization depends upon effective co-operation between governments and nations either to be dismayed even at the present moment or to relax their efforts to achieve co-operation. They must, indeed, seek rather to be ready to seize the opportunity for constructive statesmanship, when it has been won from the aggressor and respect for the rights of others re-established. Apart from the moral issues upon which the conflict has been joined there is, indeed, welcome evidence to be found of the success of efforts in this direction in certain fields.

Among such evidence may be cited the encouraging report of the special committee which was recently appointed by the Council of the League of Nations to consider how best international co-operation could be developed in economic and social affairs. The pre-occupation of public interest with the League's efforts to abolish war, and disappointment over its failure to create an effective system of collective security, have led to failure to appreciate its success in other directions. Even those who are aware that most of the League's activity has been concerned with social and economic problems have little idea of the varied character of this activity, and how beneficial have been its results.

The report of this special committee should redress the balance. The progress of civilization is dependent to a growing extent on economic and human values, and in such diverse problems as the prevention of unemployment or of wide fluctuations in economic activity, the provision of better housing, or the suppression and cure of disease, purely national action cannot find a complete solution. The mechanism of international co-operation which has been built up by the League is rendering invaluable service to the world as a whole in meeting these needs. Moreover, the way in which the world is becoming closer knit, in spite of political severance, and the growing similarity of the form of economic structure in different countries and of the difficulties for which they must find solutions, are powerful factors even at the present time in stimulating the expansion and development of the League's work in such fields, and in the scientific approach to such questions as nutrition, housing and health on an international scale.

International discussion offers a further advantage in affording a safeguard against the effect on governments of sectional influences at the expense of the general welfare. The growing material and intellectual demands which men make on life, the consciousness that a better use of the scientific and productive resources of the world could improve their living conditions out of all knowledge, the impatience for some real

and concerted effort to raise the standard of living near to what it might become, are yet further factors reinforcing the tendency towards international co-operation. Indeed, it may well be expected that the very sacrifices and renunciation which citizens in Great Britain have so willingly made of the advantages which modern science had placed in their hands, whether in the domain of communications and transport, lighting, entertainments, which within a couple of decades or so we had come to take for granted, will stimulate a further and more determined effort after the war both to extend such advantages and by international co-operation to make them secure from interruption again.

The picture which this report gives of the variety and success of the League's work in the checking of epidemics, the control of disease, the suppression of the traffic in opium and other narcotics, and in women and children, or the regulation of international communications or the pooling of experience and investigations in such problems as nutrition or the causes of economic depressions, is not altogether unfamiliar to many scientific workers. The present report, however, gives a concise summary of the real advantages of the League's organization and the way in which it is able to make a uniquely economic contribution. Its resources enable it to collect and sift evidence drawn from all over the world, to obtain the services of the best experts and arrange meetings between them, and to provide the essential links between experts and those responsible for policy, as well as opportunities for statesmen to meet and discuss their policy, and machinery for the conclusion of international agreements. As Mr. Cordell Hull recently wrote to the Secretary-General: "The League of Nations has been responsible for the development of mutual exchange and discussion of ideas and methods to a greater extent and in more fields of humanitarian and scientific endeavour than any other organization in history."

Considerations such as these have led the Special Committee, of which the Right Hon. S. M. Bruce was chairman, to its proposals for extending the work of the League in this field and increasing its efficiency. It recommends that a Central Committee for Social and Economic Questions should be created to supervise the work and co-ordinate the efforts of the many different agencies engaged in it. This committee would direct and supervise the work of the League committees dealing with social and economic questions, and appoint the members of the standing technical committees so far as possible. It is further proposed that, to give States which are not members of the League the opportunity of the fullest co-operation in the work itself as well as in its direction, non-members of the League should be represented on the committee on the same footing as the member States, and that the committee should have power to co-opt non-official members experienced in economic and social affairs.

These proposals should facilitate a clearer separation between the political and non-political work of the League, and provide a permanent basis for the development of the economic and social work of the League. Apart from this development, such separation may be of value in retaining the structure of the organization if, after the war, it is expedient to make a fresh start to secure the goodwill and co-operation of Germany and other nations.

Nor is it only on the social and economic side that we have been reminded of the forces still working for international co-operation. Two papers prepared for presentation before the Division for the Social and International Relations of Science at the Dundee meeting of the British Association deal with the question of international intellectual co-operation. Prof. Gilbert Murray describes the purpose and organization of the Committee of Intellectual Co-operation and the various types of conference organized under its auspices or in association with other bodies, such as the International Labour Office. He refers, for example, to the study of science and social relations, such as the effect of scientific invention on industrial conditions, and the proposal of the International Labour Office to include men of science in its conferences.

Prof. Gunnar Dahlberg's paper is mainly concerned with the question of translation of scientific papers. Organization of the facilities of translation would, he considers, facilitate international co-operation for the smaller countries, and Prof. Dahlberg supports the idea of a world language in science. He also stresses the value of informal conferences on special problems between leading men of science from different countries.

If the possibilities of international conference on any scale are remote at the moment, the move-

ments and tendencies in the field of intellectual co-operation, no less than in the economic and social sphere, should remind us of the hard thinking and preparation which are yet to be done if opportunities are to be seized as they present themselves.

We have entered on this struggle to prevent further encroachments on freedom of thought and speech and investigation; but freedom can be endangered even in such a cause as that for which we contend. If the fruits of victory are ultimately to be reaped, we must bring to the struggle not merely the full force of our moral and material resources, but also constructive and imaginative statesmanship ready to build on whatever remains from the present wreckage of our hopes. Science, at least, has given men a vision of the world that might be when man's moral and spiritual development is in keeping with his material advance. If that world is ever to be realized, scientific workers, amid the stress of the present emergency, must guard zealously their loyalty to truth, not less than their belief that science transcends national frontiers, and that mankind will only enter on its full heritage through international co-operation and understanding, and the mutual respect and good faith upon which alone such co-operation and understanding are possible.

AN ENCYCLOPÆDIA OF CHEMISTRY

Thorpe's Dictionary of Applied Chemistry
Vol. 3. Chemical Calculations—Diffusion. By Prof. J. F. Thorpe and Dr. M. A. Whiteley. Fourth edition. Pp. xxiv + 608. (London, New York and Toronto: Longmans, Green and Co., 1939.) 63*s*. net.

THE third volume of Thorpe's "Dictionary" opens with a short sermon by Dr. Johnson intended especially for adverse critics. To one who has not, perhaps, been too complimentary in the past, it is indeed gratifying to find that a few chance words have deserved so much attention, for the reviewer of an encyclopædic work such as the present, not being omniscient and having no collaborators, must needs confine himself to general aspects, although, on occasion, he may be permitted to indicate an error. He can but put forward what he believes to be the views of a section of readers and make suggestions which he considers will improve the later volumes.

It was mentioned that, to justify the issue of a new serial which might become a millstone around librarians' necks, matter of exceptional character would have to be provided, and this condition appeared scarcely satisfied by the first two volumes. Another ground for complaint was that, in spite of the title and the crying need for an up-to-date book on industrial processes, the general impression of these volumes was that of a text-book on organic chemistry.

It seems too much to hope that these remarks have borne fruit, but the fact remains that the third volume is something different. It is possible to turn over page after page without seeing an organic formula, and references dated 1936, 1937 and even 1938 abound, while, when preparing a list of the more important contributions, it is necessary to write "new" with almost monotonous regularity.

The volume opens with an excellent article on chemical calculations, a title which unfortunately does not indicate the scope of the contents. It includes triangular co-ordinates, nomograms and graphical methods of calculation in general, or, as the author puts it, "methods of saving time in calculating". It should be read by all chemists, and physicists too. Other general articles include "Chemical Warfare", beginning with the words: "Chemical warfare is prohibited by the Geneva Protocol of 1925," but none the less doubled in length since the issue of the supplement and containing a concise account of the subject with good bibliography; "Colloids", a brief but clear survey; "Colorimeters", a lucid treatise on modern instruments, their uses and the theory of colour measurement, which should be in the hands of all those who have to deal with the subject; "Condensers", in which the author has shown his ability to condense matter other than vapours by discussing in eight pages, largely occupied by illustrations, the history of commercial and laboratory condensers, types for special purposes, condensers used in industry, the corrosion of condenser tubes and the theory of condensation, the whole being interspersed with more than one hundred references; "Co-ordination Compounds", extended from the supplement and brought up to date to form a comprehensive review; "Corrosion and Protective Measures", occupying thirty-two pages, which must perhaps receive a prize for the admirable way in which it deals with the many aspects of this controversial but important subject; "Crystallisation", a good article with adequate diagrams,

dealing with the principles underlying what was until recently an empirical process; and, finally, "Diffusion", in which the phenomenon is considered mainly from the laboratory aspect—in view of its importance in industry, a more comprehensive treatment would have been desirable, but perhaps there is to be an article on diffusional processes.

There is but one black spot, mentioned on a previous occasion, and that is the risk that these valuable articles may escape notice. The man in the street wanting information on mustard gas would think he must wait some years for M or G or P, while the chemist might look up "Chlor" but obtain no satisfaction. Even if an abbreviated index is not possible, a list of general articles to date would be of much service to the reader.

The longer articles dealing with individual substances or groups of substances have been mostly rewritten, in many cases by those engaged in actual manufacture, and a fair number of new diagrams has been introduced. A particularly pleasing example is "Benzol Recovery", while "Chloroform", although taken from the older edition and ruthlessly mutilated, is still able to remain a gem. It is difficult to say whether "Cinchona Alkaloids" or "Cyanides" is the outstanding contribution in this class. Each occupies some fifty pages and summarizes our present knowledge with a conciseness not likely to be found elsewhere. A new contribution, "Coal Tar", with explanatory diagrams, serves as a good introduction to modern distillation methods, while "Chlorine", partly rewritten and enlarged, contains among much other information a useful account of electrolytic cells. Space does not allow discussion of all the three hundred and ninety-five headings dealt with, and thus it must suffice only to mention "Cobalt" and "Copper" with their important alloys, "Citric Acid" and "Cider" among the natural products, and "Cyanine Dyes", "Diazo Compounds" and "Cocaine" with its derivatives, as illustrating some recent developments of organic chemistry. Finally, "Deuterium", practically unknown when the last edition was published, has now an extensive literature which has been collected and abstracted to give a very complete account of the properties of the element.

To summarize: volume 3 appears to be a great advance on its predecessors and to approach very nearly the ideals of its authors. May the high standard they have set up continue and may they find, with Dr. Johnson, that "useful diligence will at last prevail". H. E. W.

FIRST YEAR UNIVERSITY BOTANY

An Introduction to Botany
By Prof. Arthur W. Haupt. (McGraw-Hill Publications in the Botanical Sciences.) Pp. xii+396. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 18*s*.

An Introduction to Botany
with Special Reference to the Structure of the Flowering Plant. By Prof. J. H. Priestley and Lorna I. Scott. Pp. x+615. (London: Longmans, Green and Co., Ltd., 1938.) 17*s*. 6*d*. net.

A GOOD many university botany schools have now published their first-year teaching courses as text-books. They vary strikingly in subject, but this may make little ultimate difference as gaps can be made good in the next two years; it may also matter very little whether the wide survey method or intensive study on 'types' is used. The student's attitude to his work at the end of the year is what is of fundamental importance.

All teachers must have seen a freshman of promise, starting with a childlike thirst for knowledge, who in a year or two became dull, seemingly bent on acquiring the minimum of knowledge (and very likely failing in that). However little the teacher is to blame, it may well be that this disaster would have been prevented by other methods. Of great importance, too, is the student's attitude to his practical work, whether he makes a record of his observations which he is prepared to trust when, for example, it conflicts with book or lecture. Perhaps a student cannot greatly increase his inventiveness and power of logical thought; but these virtues can be put to sleep by wrong teaching.

While it is the nature of a text-book to supply facts, some writers show their preoccupation with education (as apart from instruction) more obviously than others.

(1) Here are two books, both good. Haupt's shows a very normal balance and excels in the simple way every subject is treated.

There is no doubt that a student who wanted a book to supplement his lecture notes would like it; and if his botany ends with the year, it may be just right. It is an easy book because it is well arranged and well expressed, and sometimes

because things are made to seem easier than they are; for example, in the section on transpiration the reader would certainly suppose that light causes stomata to open through increased sugar formed simply by their own photosynthesis. It may be well to save a muddle by withholding queer facts, but only if the reader is made to realize that he has not anything like the truth. It must be more difficult afterwards to teach the mechanism of a stoma where a slick and wrong notion is held than where there is none. On the other hand, it may be that the student will be so interested and encouraged by his ability to understand that he will surmount his difficulties none the worse.

(2) Priestley and Scott's book is unusual in balance; nine tenths is on the flowering plant, though the continuation of the title "with Special Reference to the Structure of the Flowering Plant" is barely just, for structure is only considered in relation to function. Tables of real data are included; they may not always prove their point, but they are exactly the sort of measurements students can make, and they are as ragged as an honest student's results. It may be said that this book is unique in fostering scientific honesty by glaring examples. Much of the subject matter is equally fresh, and the teaching reader is sure to find ideas to incorporate in his own course.

Difficulties are faced wherever they arise, but scarcely so admirable is the way some are met when there is no apparent need; there is, for example, some discussion of plastochrones and the significance of Fibonacci phyllotaxis. Causal explanations are given throughout, but sometimes on an inadequate basis. It is said that the modification of gorse leaves to spines "appears to be due to lack of sufficient water", and as evidence is given the statement that in wet seasons gorse shoots often revert to the flat seedling foliage. Gorse, however, develops fierce spines in western Ireland (where it is surely wet enough) and in gardens along with soft-leaved plants. It is, however, only just to say that this is an extreme example, and the risk to the student is the less since a causal explanation at once suggests an experimental test, or original observation.

T. M. H.

EXPERIMENTAL EMBRYOLOGY

Form and Causality in Early Development

By Prof. Albert M. Dalcq. Pp. vi+197. (Cambridge Biological Studies.) (Cambridge: At the University Press, 1938.) 12*s.* 6*d.* net.

THE fertility of its ideas and the widths of its interests have combined to make the Brussels School of Embryology under Prof. Dalcq a centre whose work and activities are of the greatest interest and importance to all biologists. It is therefore particularly valuable to have Prof. Dalcq's views succinctly set forth in this volume which he has written in English.

Few are the aspects of experimental embryology to which the author and his colleagues have not made original contributions, and the present work is, essentially, a synthesis of modern views based on experimental evidence of the time-honoured problem of the causality of form-production in ontogenetic development. Space is lacking in which to do justice to the many important problems raised in this book, such as the progressive development of the inductive power of the organizer, the potencies of the ascidian egg, or the nature of the phenomenon of regulation. But attention must be paid to what is, really, the point of chief interest and importance of the book, namely, the attempt to formulate an explanation of the repartition of the presumptive organ-forming regions of the chordate egg. This the author ascribes to the combined effects of processes associated with a gradient in the cortex of the egg having its high point at the site of normal formation of the dorsal lip of the blastopore, and a gradient in the yolk the repartition of which is under the influence of gravity. A dorsal lip invaginates at the normal site, or at a place nearest this site in contact with yolk, and sets up an organizing centre. By introducing the concept of threshold qualitative response values in the gradient field set up by the above-mentioned gradients, a formal explanation can be arrived at of the distribution of the presumptive notochord, mesoderm, neural plate, and other territories.

The concept is nothing if not bold, and extends in many ways the views which have now for some time been associated with the name of Child. If Prof. Dalcq's views can be substantiated, then indeed a capital step will have been taken. The author would be the last person to deny the necessity for further experimental evidence to establish his hypothesis beyond question; and there are difficulties. But already his hypothesis enables acceptable interpretations to be given of results which have seemed baffling, such as

Yamada's experiments on the differentiation of presumptive notochord into structures of 'sub-notochordal' rank; or Lopaschov's demonstration of the differentiating powers of massed organizers.

Another very important aspect of Prof. Dalcq's position is his derivation of gradient fields from pre-existing oocyte organization and not as a result of the action of directional external factors. This has an important bearing on the problem of preformation and epigenesis, and also points the way to a field of new work on gametic cytology. But enough will by now have been said to bring to the notice of all biologists the fundamental importance of Prof. Dalcq's work.

G. R. DE BEER.

FORESTRY IN INDIA

Manual of Indian Silviculture

Part 1: General Silviculture, by H. G. Champion; Part 2: Silvicultural Systems, by Sir Gerald Trevor. Pp. xv+374+33 plates. (London: Oxford University Press, 1938.) 30*s*. net.

SINCE the establishment of the Forest Research Institute at Dehra Dun in 1906, Indian sylvicultural knowledge has advanced rapidly. Two manuals of Indian sylviculture had been written at different times before then, but these have long been out of date. The appearance of the present work, therefore, is to be welcomed. Its joint authorship does not imply collaboration. The two portions of the book—(1) "General Silviculture", by Champion, and (2) "Silvicultural Systems", by Trevor—might equally well, and perhaps with advantage, have been published as separate works.

Champion's contribution, which occupies more than three-quarters of the whole, breaks much new ground, and its general arrangement is logical. The subject matter is dealt with in eight chapters: i, the locality factors of the forest; ii, growth and form of trees and crops; iii, tree and crop physiology; iv, forest composition and distribution; v, natural regeneration; vi, artificial regeneration; vii, afforestation; viii, tending. Each chapter is subdivided into well-defined sections and subsections which facilitate reference, and although the style is terse and sometimes even brief, a comprehensive list of references to literature appears at the end of each chapter. In this way much ground is covered within a reasonably small compass, while the reader is put in possession of the necessary references for further details. While general principles are expounded, the author is at pains to apply them strictly to Indian conditions.

Under locality factors, special attention is paid to the important question of the soil. Admittedly our knowledge of forest soils, particularly in the tropics, is as yet far from complete; nevertheless, this section should prove of much value to students of tropical sylviculture. A noteworthy feature of tropical forest soils is the absence of decayed leaf litter, owing to the rapid decomposition in warm climates; this may be observed even in rain forest with a yearly production of 100 tons of fresh organic matter per acre. Typical *p*H values are given for different forest soils in India, the most acid being red laterite (4·5) and the most alkaline black cotton soil (8·7–9·0) and alkali soil (9·6–10·4). In the irrigated areas of the Punjab, it has been found that soils with *p*H exceeding 8·5 cannot be satisfactorily planted with *Dalbergia sissoo*; up to 9·0 several of the indigenous trees can grow, but above 9·5 the soil is barren.

Among the many biological questions relating to forest trees and crops that are dealt with may be mentioned conditions of flowering and seeding, seed dispersal, the establishment of seedlings (including the phenomenon of 'dying back'), root competition, the inheritance of parental characters, and water and light relations. Part 1 ends with a useful discussion of artificial regeneration and tending, and stress is rightly laid on the importance of shifting cultivation as a basis for the formation of forest plantations.

Part 2, on sylvicultural systems, by Sir Gerald Trevor, following the arrangement and substance of Troup's "Silvicultural Systems", enumerates the various systems developed in Europe, and gives examples of the application of these systems to Indian forestry. It is of particular interest to note how the systems of Europe have been adapted successfully, with suitable modifications, to the varying conditions in India. Leaving out of account the management of bamboo forest, which does not concern European forestry, and the rough selection fellings employed as a provisional method of working, it may be said that, apart from local modifications, there is no Indian system described in the book that is radically different from one or other of the recognized systems of continental Europe. This is ample testimony to the soundness of the policy at one time in force of including in the training of probationers for the Indian Forest

Service a period of practical study in those European countries in which the standard sylvicultural systems are well exemplified. Some of these systems are now so well established in India that they furnish examples equal to anything to be found in Europe: this only serves to emphasize India's indebtedness to Europe, a fact that is sometimes overlooked.

The style of the book is attractive and the illustrations are good, though in some of the titles the omission of the locality to which they refer detracts somewhat from their interest.

THE HYDROLOGY OF THE UPPER WHITE NILE

The Nile Basin

Vol. 5: The Hydrology of the Lake Plateau and Bahr El Jebel. By Dr. H. E. Hurst and Dr. P. Phillips. (Ministry of Public Works, Egypt: Physical Department Paper No. 35.) Pp. x+251+103 plates. (Cairo: Ministry of Finance, 1938.) P.T. 100. 20*s*.

SINCE 1931 the Physical Department of the Egyptian Government has been issuing at intervals the volumes of a publication "The Nile Basin", written by Drs. H. E. Hurst and P. Phillips. The earlier volumes have contained descriptive matter and statistical records of hydrological observations of the Nile and its basin. The series has now been crowned by the volume under review, which summarizes and discusses the results of thirty years' river survey in the Sudan, upon which work Egypt has spent money both generously and fruitfully.

The excellent and numerous maps and diagrams that accompany the text have been reproduced by the Survey of Egypt, from which the Physical Department has sprung. One is reminded by this instance of co-operation of the principle advocated before the British Association in 1929 by Brigadier E. M. Jack, that the several survey branches of any country's administration should be as closely related as possible.

"The Nile Basin" is a book of a type of which unfortunately far too few examples get published. Mankind is comparatively well supplied with information as to the resources of the heavens and the earth itself but, as was noted by Galileo, knows little of the freshwater resources of the globe. So much is this the case that, when anything on the subject is reported in a British technical journal, the indexer usually is at a loss to classify it suitably and places it under some such heading as 'Water Supply', that is, distribution, whether the resources have been put to use or not. In this connexion, reference may be made to a recent Stationery Office publication, in which on an advertisement page the Surface Water Year-book of Great Britain, 1935–36, is placed under the heading of River Pollution and Fisheries.

The motives of modern Egyptian river-studies are the same as those for which the Roda gauge at Cairo has been read since A.D. 620, namely, irrigation and defence against floods. Without entangling the reader deeply in the problems of the Egyptian Irrigation Department, the authors frequently discuss their data with reference to those problems.

The task of surveying the Upper Nile is a formidable one, because of the tangle of lakes, channels and swamps in which the river-flow is gradually accumulated and through which it passes to Malakal. As the result of these physical conditions, any scheme for the conservation of the river-water in those regions in the interests of far-away Egyptian agriculture brings many factors into play. There is, however, a practical limit to the amount of survey that can be undertaken. Great care and skill have, therefore, to be exercised in extracting the maximum of accurate data for the testing of the schemes prepared.

In performing their task, the authors have, however, placed hydrologists as well as river-engineers in their debt, not only by furnishing well-arranged records of the river-system and its behaviour but also by discussing various problems and phenomena, such as the time of travel of changes of river-level and discharge; sunspots in relation to the water-levels of Lake Victoria; flow through and water-losses in swamps; the backwater effect of large rivers on one another; and gauge-discharge relationships as observed at various points on the Nile. Orthodox forms of statistical analysis have been used to an extent that is otherwise very rare in studies of this great river.

Dr. Phillips' death unfortunately occurred whilst this book was in draft form. Although hydrologists must deplore the premature loss of this valued worker, they can nevertheless rejoice as he surely would have done that this admirable record of the river-survey work of Dr. Hurst, his staff and the Egyptian Irrigation Department has now by publication been given a wider audience and endowed with permanency. W. ALLARD.

SEVENTH INTERNATIONAL GENETICAL CONGRESS

THE chief qualifications demanded of those who undertake the organization of an international scientific congress in these days would seem to be an unwarrantable optimism and a complete disregard for current political events. At no time during the last two years has it ever been certain that the International Genetical Congress would meet, and now it is indeed surprising that it ever met.

It will be remembered that the Permanent International Committee appointed by the Sixth Congress at Ithaca in 1932 accepted the invitation of the Russian geneticists to hold the next Congress in Moscow in 1937. Difficulties arose, however, which made its postponement necessary. Late in 1937, the International Committee had reason to doubt that the Congress could be held in Moscow even in 1938, and found it necessary to seek invitations from other countries. The committee of the Genetical Society of Great Britain was informed that if we in this country were prepared to take over from the Russians, we should be rendering both the science and the International Committee a very great service. Being assured that it was quite impossible for the Congress to meet in Moscow in 1938, the Genetical Society of Great Britain offered, in October 1937, to stage it in Great Britain in 1939. This offer was eagerly accepted.

The committee of the Genetical Society formed itself into an organizing committee and decided that the Congress should meet in Edinburgh. F. A. E. Crew was appointed general secretary. Since N. I. Vavilov would have been the president of this Congress had it been held in Moscow as was intended, and since we wished to indicate in the only manner available to us our great respect for him personally and our ardent desire for the active co-operation of the Russian geneticists in the affairs of the Congress, an invitation was sent to Vavilov asking him to continue in the presidency.

During 1938 and the first half of 1939, the programme of the Congress slowly took shape. At times the organizing committee had reason to think that its was a hopeless task; at others it was greatly encouraged by the eager co-operation extended to them by geneticists from all over the world. A programme built up of more than four hundred papers of quality was ultimately issued, whilst in London, Cambridge and Edinburgh preparations for the reception and entertainment of some four hundred foreign guests were completed. Yet all the while doubt lurked in the minds of all of us. It was obvious to all that the day was not far distant when the flickering lamps of science would be dimmed, and the only question that concerned us was when this day would dawn. Should we be permitted to carry this Congress to its successful conclusion before we were required to leave the forges of knowledge and use tools that we had made, for unworthy and damnable purposes?

On the morning of August 23 there gathered for the first meeting of the Congress some six hundred geneticists drawn from fifty-five different countries. There could be no grander measure of the devotion that men of science give to the science they serve than this. They met in days heavy with anxiety, to consolidate the ground won by them and their colleagues during the last seven years. The Congress had met, but it lacked a president, for, a fortnight previously, information was received that no one from the U.S.S.R. would be attending. This was a wound which at the time seemed mortal, for it had been hoped that not only would Russia supply a president but also that fifty or more papers of outstanding quality would be presented. However, the vitality of the Congress was such that it survived, and for two days into its rooms none of the loud murmurings of the outside world entered. Looking back on those days, they now seem to have been a dream of what the world itself might be were all men reasonable.

It is true that according to the records there were Americans, French, Germans, Poles, and all the rest of a great geographical and political variety, yet these were divided by no barrier of language or of prejudice. They formed one harmonious whole, moved by a common purpose, to advance a science, to serve mankind, to cultivate a fellowship. But the murmurings outside grew in intensity, and towards the end of the second day the air became disturbed, and everyone began to remember his private responsibilities and duties. The first group to be seriously affected was the German delegation (34 strong), which received advice that it would be desirable for them to think of returning home. This advice they resisted until it became quite certain that if they delayed longer they might encounter very serious difficulties in transportation; and so, most regretfully, and bearing with them the good wishes of their colleagues, they bade us farewell. At the same time, owing to mobilization of the Dutch army, the delegation from the Netherlands (17 strong) decided that it was desirable that they also should go. From that moment onwards the citizens of Edinburgh looked upon the Congress as a trustworthy barometer. Hourly inquiries as to whether

or not the Italians, the French and the Poles were still with us were received, and Edinburgh was comforted when it could be told that the French and the Poles were remaining with us, and that the Italians had no intention of departing.

The programme, of course, was sadly crippled by this time, and for a while the organizing committee considered the question as to whether or not, in the circumstances, it would not be advisable to bring the Congress to an abrupt end. However, the Congress itself decided that it should continue. There was little else that we could do save to indicate, by continuing, that science was worth serving even in days like these, and that it, of all things, offered the most enduring good to all mankind. But the Congress was shortened, for Sunday was made a working day. A brave gesture this, for it will be remembered that Edinburgh is the capital of Scotland. As things turned out, this decision was more than justified, for the meetings continued to be very well attended right to the end, and daily the congressists sat down to mighty repasts. Looking back upon the sessions from this short distance, it would seem that not one of them was remarkable for the announcement of any startling discovery, but that they were immensely useful in that, during them, differences were bridged and new lines of advance were traced.

The organizing committee received repeated expressions of congratulation for the way in which the Congress affairs were conducted. Those who congratulated us seemed to be unaware of the obvious fact that the quality of a Congress is determined not so much by its organization as by the personalities of its adherents. On this occasion we were more than ordinarily fortunate. From a great many countries there came strong delegations bringing contributions of knowledge, of friendliness, of charm. It was they who made this congress successful. To the Germans, to the French, to the Italians and to the Poles we are indeed indebted. They came at great personal inconvenience to our aid, and they have left behind them most happy memories. The coming of an American contingent, 130 strong, made the success of the Congress inevitable. But it is too much to expect that the welcome they received would compensate them for the distress that they endured when the Congress ended, for then they found themselves stranded in Great Britain with no immediate hope of return to their own. Already at least seven of them have been exposed to the gravest danger, for these were passengers on the *Athenia* and their fate at the moment of writing is not known. Some forty others have still to make the dangerous passage.

At the first business meeting of the Congress, F. A. E. Crew was elected to the presidency rendered vacant by N. I. Vavilov's absence. A Permanent International Committee, consisting of C. L. Huskins (Canada), O. Winge (Denmark), Boris Ephrussi (France), Von Wettstein (Germany), F. A. E. Crew (Great Britain), A. Ghigi (Italy), M. J. Sirks (Netherlands), Otto L. Mohr (Norway), G. Dahlberg (Sweden), A. Ernst (Switzerland), M. Demerec (United States of America), was appointed. This committee later elected F. A. E. Crew as its chairman.

At the second meeting of the Congress it was agreed that, in the circumstances, it was quite impossible at this particular time for the International Committee seriously to consider invitations and to decide as to the time and place of the next congress. It was intimated that invitations had been received from Italy and America. The International Committee was given authority to designate the time and place of the next congress at some later date.

Following a motion brought forward by the International Committee, the Congress decided that it should not be regarded as essential or necessary for future congresses to publish *Proceedings*. This decision was reached because it was recognized that, in the past, a number of invitations to meet therein had not been received from several countries on account of the expenses that are associated with the publication of the *Proceedings*. It was recognized that complete autonomy must be given to the actual organizing committee of a particular congress as to whether or not *Proceedings* of that congress should be published.

The Congress considered the setting up of an international committee which would devise a scheme whereby animal and plant stocks of genetical importance could be maintained in times of emergency. The International Committee was asked to consider the matter and set up a committee for this purpose.

During the course of the Congress a group meeting was arranged for the discussion on the statistical requirements of the student of genetics. At the end of this meeting the following resolutions were passed :

(1) That the teaching of statistics should be carried out in conjunction with the teaching of practical genetics.

(2) That elementary statistical methods, in particular tests of significance and their validity, should be included in the ordinary mathematical courses given at secondary schools.

(3) That the General Secretary of the Seventh International Congress of Genetics be requested to transmit copies of resolution 2 to any educational bodies which he considers may be able to assist in its fulfilment.

(4) That the genetical societies of countries

represented at the Seventh International Congress of Genetics be requested to discuss the teaching of statistics in relation to genetics and to transmit their final resolutions to the next congress.

In connexion with the Congress, a meeting of mouse geneticists was held on August 24 to consider a set of nomenclature rules drawn up by a recently formed Committee on Mouse Genetics Nomenclature and to discuss details of a Mouse Genetics News Service. The director and staff of the Roscoe B. Jackson Memorial Laboratory in Bar Harbor, Maine, U.S.A., have offered facilities for the publication in mimeographed form of the *Mouse Genetics News*. It was suggested that a register of stocks and the various pure lines should be drawn up; this should end the confusion in the naming of pure lines used in various laboratories which has arisen during the last few years. Stock lists of all the laboratories concerned should be published from time to time. It was further suggested that notice should be given by a laboratory before any stocks are discontinued; it has happened several times in the past that valuable material has been irretrievably lost, because every laboratory has relied on other places for its maintenance. The News Service should also arrange for exchange of stocks, and it is hoped that its activities may be extended to rabbits and other rodents. The meeting also discussed the establishment of centres, preferably in the United States, for the maintenance and safe keeping of stocks, particularly of genes (pathological and otherwise) which are not purposely kept by the fancy. It was urged that this matter should receive the immediate consideration of the News Service, and that an appeal should be made to the Carnegie and Rockefeller Foundations for financial assistance.

F. A. E. CREW.

MEASUREMENT IN PSYCHOLOGY*

BY R. J. BARTLETT

IN the opening paragraph of "Psychology Down the Ages", Prof. C. Spearman concludes a list of difficulties facing any who seek to define psychology, with the questions: "Do the data at its disposal include what can properly be called 'measurements'? Is it, or can it ever hope to be, or should it as much as try to be, a systematic science at all?" Dr. William Brown, in the realm of medical psychology, answers the first question in the negative. Forced into metaphysics, he writes: "Determinism, although a postulate for psychology, cannot be accepted as anything proved. In physical science there is empirical proof of it to a certain extent through measurement. By measurement we can prove to a certain extent, within certain limits of error, the conservation of mass, the conservation of energy. . . . But there is no measurement of that sort possible in psychology. . . . The observations of psychology are primarily qualitative, not quantitative." But the writer of "Essentials of Mental Measurement" could not leave it there. He added a footnote: "But mental measurement, in a derived form, is possible in the domain of mental tests and of the psycho-physical methods."

The conflict between philosophy and experimental psychology, thus exemplified, is of long standing. Malebranche argued that mental states could be distinguished qualitatively, but not quantitatively. Leibniz declared that mathematical treatment was impossible in psychology as it lacked continuous magnitudes. Kant said that psychology possessed no mathematical magnitudes for the reason that, "whereas the phenomena of matter possess two variables, space and time, those of mind have only the single one, time". For these and many later philosophers psychology possesses neither measurable phenomenon nor the means to measure. Still worse! Some physicists seem to have reached the same conclusion. For them measurement is impossible in psychology.

Notwithstanding criticism from philosophy and physics, the word measurement is deeply imbedded in the literature of psychology, and of late years its use has been greatly on the increase. Experimental psychology is little more than fifty years old. Galton's "Inquiries into Human Faculty" appeared in 1883, Wundt went to Leipzig in 1875, Weber died in 1878 and Fechner in 1887. Since then an ever-growing body of workers has been applying experimental method to psychological problems and developing its own methods of measurement and mathematical treatment of data obtained. Contemplating this work against the declaration that measurement is impossible in psychology, Prof. Spearman comments: "But the path of science is paved with achievements of the allegedly unachievable. And in point of fact, mathematical treatment is perhaps just the region where psychology has made its steadiest

* From the presidential address to Section J (Psychology) of the British Association, delivered in Dundee on September 1.

and most surprising advances." My task is to attempt a review of experimental psychology that will reveal the senses in which the word measurement is being used by psychologists.

Psycho-physical Measurements

When we turn to actual measurements being made in psychological laboratories, we find in use metre scales and foot rules, balances and weights, chronoscopes and stop watches, resistance boxes, galvanometers, photometers and any other measuring instrument that ancient wisdom or modern physics has made available and happens to be of service in the task in hand.

One general group of tasks consists in measuring the results of bodily activity carried out under controlled conditions. Take as an example the product of a person's behaviour when asked to draw lines on blank foolscap paper of length equal to half the width of the paper. In one experiment 2,048 such lines were drawn and measured. It is probable that no two lines were exactly the same length, and that measurement to 0·01 mm. would have proved this, while obscuring a law binding them together.

Choosing a coarser unit, we measure to the nearest millimetre and find 92 lines of 103 mm. length at the modal value of results scattered from 69 mm. to 135 mm. Relative to the material our unit is still fine, so by addition we find the numbers of lines that would have fallen into each group had we measured with units 2, 3, 4, 5 and 6 mm. respectively. With increase of the size of unit the numbers approximate more and more closely to a smooth curve. Further, as we take out the figures for measurement with a unit of 6 mm., we recognize in them an approximation to the terms of the binomial expansion $(1+1)^{11}$. Then, using the slightly smaller unit of $5\frac{1}{2}$ mm., we obtain a very close approximation to the binomial point curve. For a particular case we have established the fact that by suitable choice of unit our experimental data fall into groups closely approximating to the binomial distribution of their number, 2048. This is but a particular case of a general law.

The Gaussian continuous function, commonly called the *normal curve* or *curve of error*, in the form

$$y = \frac{N}{\sigma\sqrt{2\pi}} e^{-x^2/2\sigma^2}$$

gives close approximations to the values of binomial distributions, and is usually taken to represent the law of distribution of the results of the bodily expression of mental intention. The frequency with which results of this nature are obtained in psychological experiments leads to the conclusion that an appreciable scatter is an essential feature of our data, and that, while the old-time physicist or chemist can rest satisfied with the mean of two determinations, we must make at least fifty before we can be reasonably sure of the values of our constants. Experimental psychology could have made little progress without accepting what Dr. Darwin, last year, in his presidential address to Section A, called "the fuzziness inherent in absolutely all facts of the world", when he was arguing "that the subject of probability ought to play an enormously greater part in our mathematical-physical education".

Kant reached the conclusion that mind had but one variable—time. Without accepting his conclusion, we can concur in the importance of the time factor in mental happenings, and appreciate the part played in psychology by the Wheatstone-Hipp chronoscope, stop watches and other instruments for measuring and recording time intervals. Starting from comparatively simple beginnings, reaction times of more and more complex mental activities were determined, and the chronoscope has become for the psychologist what the balance is for the chemist.

It would seem undeniable that intensity is a characteristic of sensory experience. When we attempt to evaluate this quantitative element in sensation we are met with difficulties. First comes the fact that the same material object may be perceived by sensations that vary greatly in intensity. The intensity of experienced sound of an express train is as a rule different for a passenger comfortably sitting in it and for a would-be passenger standing on the platform as it rushes through a station. The intensity of the noise of a ticking clock sinks below the threshold when we are engaged in an absorbing task, but the energy output of the clock remains reasonably constant. The same source of stimulation occasions different intensities of sensation according to the subjective attitude of the recipient of the energy falling upon the sensory organs. To secure consistent results it is necessary to control the conditions, and in experiments involving sensation-intensity this is done by arranging that the subject shall give undivided attention to the stimuli. The maximal intensity thus obtained is accepted as constant for the given stimulus.

Normally we do not discriminate the intensity of the sensation, nor are we interested in the particular sensation itself. Our interest may be in the pleasure tone of the whole sensation complex, as when enjoying music or a glorious bank of flowers, but, more often, our interest is in the properties of the external objects that occasion the experience. The lightning's flash, the trumpet's

blare are ominous portents, rather than intense sensations. This preoccupation with the things of the external world has given us science but makes introspective analysis of experience difficult. It endows sound, light and matter with 'intensity' which we proceed to measure with acoumeters, photometers and a balance. For the psychologist, however, these measurements are only of interest so far as they may help to throw light on the problems of sensory experience.

Early in the life of experimental psychology the smallest change in the stimulus value that could be appreciated in sensation became the subject of inquiry and, for the determination of this difference threshold, difference limen, least perceptible difference or just noticeable difference, the psycho-physical methods were developed and gave to psychology a technique the wide serviceability of which does not even yet seem to be fully appreciated.

[Mr. Bartlett here discussed the Weber ratio.]

Physiological Investigation

Another branch of experimental psychology busies itself with the physiological concomitants of emotional experience. On a smoked drum record of a subject's breathing, measurement can be made of frequency and amplitude, and changes therein can be compared with introspection records to find out their meaning. The inspiration-expiration ratio, with varying emotional states, shows marked variations from the average value, rising to as much as three times that value in 'amazement' and sinking to about half the value under the sense of guilt or shame awakened by conscious misrepresentation or wilful falsehood. These changes in the ratio of inspiration to expiration are accompanied by marked changes in frequency, amplitude and form, which result in characteristic curves that the eye can read and interpret without recourse to the millimetre scale and time record. The whole profile, rather than its analysis, is diagnostic.

Intelligence Tests

An entirely different method of measurement had by 1920 reached the stage where it could not be ignored. Intelligence tests were being widely used, and the Board of Education set up a consultative committee to report "on psychological tests of educable capacity and their possible use in the public system of education". The report appeared in 1924, and the principal findings of the committee were: "That up to the present the only kinds of psychological tests of educable capacity that have been sufficiently developed to be of much service in schools for the purpose of diagnosing and assessing such capacity are tests of 'intelligence', standardized scholastic tests, and to a less extent vocational tests". Let us consider the first of these.

The foundations of the method are laid in Binet's happy thought of 'mental age' and Spearman's application of methods of correlation to psychological data. Prior to Binet's work, testing had been confined almost entirely to tests of sensory discrimination. Spearman proceeded to calculate correlation coefficients between the results of such tests and estimates of intellectual ability. Binet, "instead of measuring the intensity of simple faculties", set out by tests "manifold and heterogeneous . . . [to] measure acts of adaptation . . . to determine how many years an individual is advanced or retarded". His measure is a time measure based on the normal development of intellectual ability. Originally his "manifold and heterogeneous" tests were 54 in number, used for the diagnosis of mental deficiency. This number has steadily increased until, in the New Revision of the Stanford-Binet Scale, issued by Terman and Merrill in 1937, there are two sets of 129 tests each, covering mental ages from 2 years to 22 years 10 months and providing for Intelligence Quotient values up to 170 for children and up to 152 for adults.

By correlation methods, Spearman compared the results of tests of sensory discrimination and estimates of intellectual ability, inaugurating a new phase of mathematical activity in psychology, in which, again, the tasks led to new methods. The correlation between two sets of measurements or rankings is a measure of the extent to which the sets of figures agree, and this agreement would seem to be due to a common factor in the abilities measured. It follows that "when any pair of abilities are to any extent correlated with each other, to this extent *they can be regarded as depending upon a common factor*. . . . Otherwise expressed, each of the abilities may be taken to involve two factors, the one common to both, the other specific to that ability alone". Extending this thought to more than two abilities, Spearman developed his theory of two factors, and evolved various criteria for establishing the existence of the relations that fit the theory, culminating with the tetrad equation, $r_{ap}r_{bq} - r_{bp}r_{aq} = 0$, and its probable error.

Vocational Tests

The Educable Capacity Report of 1924 gave limited approval to vocational tests, but concluded that "the range of such tests [was] not yet sufficient for any recommendation". The Medical Research Council, through the Industrial Fatigue Research

Board, had been busy with the problem for some years, and in 1922 this Board, in co-operation with the National Institute of Industrial Psychology, undertook a preliminary investigation into the possibilities of vocational guidance. The group of psychologists who, under the leadership of Prof. Cyril Burt, carried out the investigation, reported in 1926. The research had shown that both stability of employment and satisfaction are greater among those who had obtained employment in keeping with the recommendations made on the basis of the test results than amongst those in other employment, and that it would seem true that the methods used "will prove of the utmost value to the individual and to the community, to the employer and to industry as a whole".

Since 1926 much work has been done on vocational guidance, both by the Board, under its new title of Industrial Health Research Board, and by the National Institute of Industrial Psychology. As a result of investigations carried out by these bodies and many individual research workers, in Great Britain and other countries, tests for abilities and skills of value in industry, and for particular disabilities that unfit for certain occupations, are available and are being used with increasing frequency.

Much progress has also been made with the measurement of temperament and character, a valuable summary of which will be found in Report No. 83 of the Board. In this report, Vernon reaches the conclusion that, while tests to measure attitudes or interests have not the objectivity and accuracy achieved by tests for abilities, and character and temperament traits present even greater difficulties, good progress has been made, and, with a better understanding of the methods and meaning of the results of factor analysis, "we may hope before long to achieve a fairly complete classification of all our psychological measuring instruments which would be of the utmost value in many branches of pure and of applied psychology".

The order of progress has been: the measurement of intelligence; the measurement of special abilities and skills; the measurement of attitudes and interests; the measurement of temperament and character traits. To deal with the growing complexity of the material, mathematical theory and technique have been developed until sometimes there seems danger of losing the facts in the figures, and it becomes necessary to remind ourselves that mathematical analysis cannot confer value on valueless data. The methods by which the data are collected are of prime importance. In the earliest work the instruments used were the ordinary scales of physical science; what a man did or judged was submitted to measurement in millimetres, grams, foot-candles, pitch, thousandths of a second, ohms. Physical measurement was possible, and, too often, was equated to the mental experience.

When physical measurement is impossible, we may be able to secure rankings. Most people can arrange colours, pictures, persons, poems or holiday resorts in an order of preference.

[Mr. Bartlett then discussed ranking, grading and rating.]

Personality Characteristics

We pass from attitudes towards persons and things to the question of personality characteristics. Here, as a rule, the scale that we use is completely subjective, the judges' opinions of the extent to which the characteristic is present being expressed in some recordable form. The judge may decide that his own or another's 'adaptability' is poor, fair, good, very good or excellent, and these classes may be turned into numbers 1 to 5. He may class a person as schizophrenic, schizoid, schizothyme, neutral, cyclothyme, cycloid, cyclophrene. He may rank persons by the usual techniques in order of merit or assess value by giving marks up to 10 or 20. He may approximate to an objective standard by the so-called 'man to man' scales, in which two persons are selected as exhibiting the trait in extremely high and extremely low form, respectively. Then a person is chosen that falls halfway between the extremes, and then two others halfway between the central person and the extremes. We have thus a scale of five reference values, secured by a method similar to the psychophysical method of equal appearing intervals. In using such a scale we shall find that many of those we wish to judge fall between two of the scale values and, as with a transit instrument or other reading, we find ourselves estimating halves and quarters and, with increased practice, tenths. Or again, we may objectify the distance between the scale items as lines and mark the point on the line that corresponds to the position taken by the person in the mental scale.

When a number of characteristics have been rated, they may be brought together graphically in the form of a profile, and such profiles have been found of great value in vocational selection and guidance. Instead, however, of measuring a number of individual characteristics and then bringing them together in a profile, we may rank or grade the various characteristics among themselves for a particular person, and compare that person with another by calculating the correlation between the rankings or grading of their respective characteristics. Further, if we assume normal

scatter and throw each individual set of traits into identically sized groups balanced about the central value, we can calculate the correlation by the very simple formula,

$$r = 1 - \frac{\Sigma (X-Y)^2}{K},$$

where X and Y are the actual grade values given to the various items and K is a constant equal to half the possible maximum value of $\Sigma (X - Y)^2$. The method of correlating persons had been used for some years without its essential difference from correlation of tests being clearly stated. It is to the credit of Stephenson that in his papers on "The Inverted Factor Technique" he has defined these differences and directed attention to the advantages of the method.

We have sampled the methods and results of experimental psychology and trust that the sample is a fair one, though possibly somewhat overloaded with ancient history that has become of interest to physicists in contact with the human factor. The sample is statistically inadequate, but has, we hope, enabled the mind to perform its accustomed trick of reaching conclusions from cues or data logically and mathematically altogether insufficient. We have seen psychologists using physical measurements and developing methods of dealing with the new forms of data so obtained. We have seen them following intuitive perception in the belief that their material had quantitative elements not at present amenable to the measurements of the physicist, replacing the scales of physics by estimates, ranking, grading and rating scales and developing mathematics to deal with these new data. We have seen them progressing step by step into more and more difficult fields of inquiry, and may look forward with confidence to yet greater achievements. In these circumstances, does it matter much if some continue to believe, with Malebranche, Leibniz and Kant, that our data contain nothing "that can properly be called measurements" and that it is presumption for us to think that, in any reasonable sense, our data, theories, methods and results constitute "a systematic science"? After all, there is a sense in which logical and mathematical proofs are what the psychology of advertising has called "rationalization copy". Scientific insight, as everyday perception, has ever run ahead of measurement and mathematical proof.

OBITUARIES

Prof. Edward Westermarck

EDWARD WESTERMARCK, whose death at the age of seventy-seven is reported from Finland, must always rank as one of the world's great anthropologists; and, moreover, in view of the fact that his first and perhaps most famous work "The History of Human Marriage" appeared so early as 1891, only one year later than "The Golden Bough", he can be counted among the actual pioneers of anthropology in its social aspect. Born in 1862 at Helsingfors, he might be said to be connected since his birth with its University, his father being the bursar and his mother a daughter of the librarian; and here, having graduated and taken his doctorate with a thesis on primitive marriage, he became lecturer and afterwards professor of philosophy; only deserting his *alma mater* after the War of 1914–18, when he was appointed by a liberated Finland to organize as Rector a new Swedish-speaking university at Abo.

Meanwhile, Helsingfors had always treated Westermarck with great liberality, providing him with travelling scholarships in five different years so that he might study, first in England, and later in Morocco; and afterwards tolerating an arrangement whereby, when he had served as professor in Finland during the winter months, he could spend the summer term in London as lecturer at the School of Economics and afterwards as holder of a Martin White chair of sociology. Term over in London, he would slip off quietly to Morocco, where he was as much at home as at Box Hill; and for his friends it amounted almost to a game of thimble-rig to guess at any moment where his elusive presence might be discovered.

Westermarck's first book, a masterpiece of detailed research, proved him not only to be exceedingly well informed—he had the reading-room of the British Museum to thank for that—but likewise to be a trained philosopher whose empirical leanings had led him to pay special attention to the theory of evolution. Indeed, he tells us in his autobiography ("Memories of my Life", 1929) that already by 1887 he had decided to write about human marriage on lines suggested by Darwin's "Descent of Man", and with special reference to the problem "how to explain the veil of modesty and discretion that is thrown over the sexual life". Further, Alfred Russel Wallace helped him in the preparation of his argument with critical advice, and went on to furnish his book with an interesting preface in which he praises both its thoroughness and its philosophic quality. This subject, then, Westermarck made his own, and his second and much enlarged edition in three volumes (1921), as well as the "Short History of Marriage" (1926), must always retain high authority.

A second *magnum opus*, "The Origin and Development of the Moral Ideas", is also a classic, even if

it may suffer a little by comparison with its predecessor, which dealt with a more determinate theme. Perhaps, too, it was unfortunate that the first volume, concerned largely with philosophical generalities, was issued in 1906, and the second volume some two years later; for the latter bore chief witness to the solidity of the inductive treatment on which the author relied. In "Early Beliefs and their Social Influence" (1932), various essays occur that throw further light on his views about ethics, as also about religion, towards which he adopted a frankly agnostic attitude.

His latest views on this subject are to be found in "Christianity and Morals" (1939), a considerable work full of interesting material.

It remains only to say something about Westermarck's studies of the social institutions of Morocco, which country from 1898 onwards he had resolved to make his special field of first-hand investigation. Such works as "Marriage Ceremonies in Morocco" (1914), wherein he deals largely with the magical side of marriage ritual, a subject which his "History" had passed by, or "Ritual and Belief in Morocco" (1926), not to mention various minor writings, display his infinite capacity for collecting facts, conjoined with the analytic power that can reduce an apparently chaotic material to a lucid order. Indeed, Westermarck the ethnographer would bear a most distinguished name were it not that Westermarck the ethnologist had to some extent eclipsed himself. Finland may well be proud of having produced such a man, to know whom was a liberal education.

R. R. MARETT.

Prof. M. B. Krol

THE death occurred on August 6 of Prof. Mikhail Borisovich Krol, the eminent neuropathologist and director of the clinic for nervous disorders of the All-Union Institute of Experimental Medicine and of the Second Moscow Medical Institute.

Prof. Krol was born in 1879. He graduated from the medical faculty of the University of Moscow in 1901 and at first worked as assistant in the clinic for disorders of the higher nervous activities for women in Moscow under the direction of Prof. Minor, and in a number of clinics and laboratories in western Europe. In 1921 he took an active part in the foundation of the Belorussian University and of the medical faculty in Minsk. In 1924 he occupied the chair for nervous disorders in the Belorussian University, and was elected dean of the University. In 1931 he was elected a member of the Belorussian Academy of Sciences, and in 1939 became a member-correspondent of the Academy of Sciences of the U.S.S.R.

In 1932, Prof. Krol was appointed director of the chair of nervous disorders in the Second Moscow Medical Institute and director of the clinic for nervous disorders of the Institute of Higher Nervous Activities, now the All-Union Institute of Experimental Medicine. During 1934–38 he was chief physician of the Kremlin Hospital in Moscow. In 1935 he headed the Soviet delegation to the second International Neurological Congress in London. From June 1938, Prof. Krol directed the clinical section of the Institute of Experimental Medicine. He was the author of more than a hundred scientific works in Russian and other languages, among which are several monographs of first importance. He was president of the Moscow and All-Union societies of neuropathologists and psychiatrists. He was vice-president of the Medical Council of the Soviet Union, and editor of the journal *Soviet Neuropathology and Psychiatry*.

NEWS AND VIEWS

A.R.P. for Animals

THE Royal Society for the Prevention of Cruelty to Animals has issued a very useful booklet on "Animals and Air Raids" containing the A.R.P. for animals drawn up by its veterinary experts, and the demand has been so great that a second edition was immediately required. In addition to the usual veterinary treatments for burns, injuries, and gas contamination, described in a manner convenient for animal-owners at a time when only a limited number of veterinary surgeons will be available, there are some well thought-out practical hints in these difficult problems. It is stated that there are in Greater London approximately 40,000 horses, 9,000 cattle, 6,000 sheep, 18,000 pigs, 400,000 dogs, 1,500,000 cats; that there are some 200,000 working horses in England and Wales and in addition 1,004,686 agricultural horses. For horses on the streets, a halter and 12-ft. lead is advised to control the horse while unharnessing and then securing it at a spot away from falling masonry; the nosebag should be put on to keep it calm. For small dogs and domestic animals, a gas-proof air-tight box with an opening covered by a blanket dipped in a saturated solution of chloride of lime or permanganate of potash is recommended, and a similar device against gas is recommended for adapting stables, shippons and byres.

THE Government anti-gas ointment No. 1 is among the treatments recommended for mustard gas contamination of animals, and anti-gas ointment No. 2 can be smeared on vulnerable parts of a horse, as the legs below the knee and hock joints, when it has to be led through streets that may still be contaminated. The former, a powerful irritant, is composed of equal parts of stabilized bleaching powder and vaseline, the latter of chloramine *T* in a vanishing-cream base, but it is not stable. Both ointments are only for brief treatment. Petrol swabs or chloride of lime paste with frequent washes of

soapy water are also recommended for contact with mustard gas that has not done serious injury, and hot water, soap and soda scrubbing for lewisite contact if blisters have not developed. The difficulties of providing for cats and birds, or of devising a gas mask for any animal, are stated to be considerable. Research is continuing in this work.

Royal Botanic Gardens, Kew

IT has been reluctantly decided to close the Royal Botanic Gardens, Kew, for the present owing to the impossibility of providing adequate air raid shelters in the Gardens. It will be readily understood that should an air raid occur and the Gardens were at all crowded with visitors, grave risks might be incurred. Not only would there be difficulty in evacuating the public before the gates were closed, but there would also be the practical impossibility of their being able to find sufficient shelter outside or means of transport to their homes. Even were it possible to provide air raid shelters, owing to the large extent of the Gardens and the six different means of entrance, the public would scarcely be likely to discover the shelters, however well labelled, at a critical moment, unless a large staff of wardens was available. Since so many of the staff have had to be detailed for guarding the Herbarium and other vulnerable spots in the Gardens, as well as the employees, there is no one who could be detailed to look after a large body of visitors. Adequate steps, it is hoped, have been taken to safeguard the collections in the Herbarium, the museums, etc., and work is proceeding so far as possible on normal lines.

The Toll of Accidents

THE Inter-Departmental Committee on the Rehabilitation of Persons Injured by Accidents has issued its final report (H.M. Stationery Office. 3*s*. 6*d*. net). The report refers to the loss to the community resulting from injuries by all classes of accidents as being "enormous", and the cost must run into many millions of pounds annually. Fractures in particular are dealt with, and the Committee recommends in the first instance concentration on the provision of fracture services, and concludes that the treatment of fractures can be satisfactorily carried out only in specially organized hospital departments. Some 15 per cent of all fractures are due to road traffic, and 29 per cent to industrial, accidents, and the Committee recommends a revision of the Road Traffic Act whereby the limits imposed on the amounts recoverable for the treatment of road accidents may be abolished. The Committee considers that every hospital with a medical school should have an organized fracture service, and that a period of training in a fracture department should be an obligatory part of medical students' training. Questions of organization and finance of fracture services are considered, and under the Workmen's Compensation Acts it is recommended, with certain reservations, that so long as the patient requires treatment by the fracture service he should continue to receive compensation as for total incapacity.

New Laboratory for Virus Research

THE Squibb Biological Laboratories, New Brunswick, New Jersey, have established a new laboratory for the study of filterable virus diseases. Dr. Raymond C. Parker, biologist of the Rockefeller Institute for Medical Research, has been appointed head of the laboratory, which will operate as a unit of the Biological Division of E. R. Squibb and Sons. The new building is a continuation of a programme of expansion which began in 1938 with the dedication to pure science of the 750,000-dollar laboratory of the Squibb Institute for Medical Research. Among the common diseases caused by filterable viruses are smallpox, rabies, equine encephalitis, measles, chicken pox, poliomyelitis, and the common cold. No specific product for the prevention of four of these diseases—the common cold, poliomyelitis, chicken pox, and measles—is yet available.

THE new virus laboratory, which was opened during a tour of the Squibb Institute and the Biological Laboratories on September 6–7, is housed in a specially constructed building, and is equipped for work with chick embryos and tissue culture, two of the techniques for work in this field. The actual working quarters consist of a large general laboratory equipped with every facility for chemical and histological work, a general preparation room for washing, drying, packing, and storing the various materials that are used, two special culture and operating rooms provided with filtered ventilation, a spacious incubator room, an animal preparation room, a bleeding room, and ample animal quarters. The arrangement of the rooms is such that the air of the culture suite proper is protected at all times from the air of the general laboratory and office quarters on one side, and of the animal rooms on the other. It is also possible for visitors to observe every step of the work in progress without entering any of the various rooms of the culture suite.

Experimentation and Disease

THE thirteenth Stephen Paget Memorial Lecture was delivered at the annual general meeting of the Research Defence Society on June 13 by Sir Edward Mellanby, who took as his subject "The Experimental Method in the Conquest of Disease" (*The Fight against Disease*, 27, Nos. 2 and 3). After a tribute to the memory of Stephen Paget, Sir Edward referred to the exhibition in an anti-vivisection office window of models of dogs suffering from rickets (incidentally, models of his own experimental animals), and remarked that it is difficult now to find throughout Great Britain children suffering from the same kind of deformity. Sir Edward Mellanby then proceeded to give instances in which the experimental method had solved the nature and causation of various diseases. In the case of facial paralysis ('Bell's palsy'), in 1844 Bell surmised on anatomical grounds that this form of paralysis was caused by paralysis of the facial nerve, and demonstrated the truth of this surmise experimentally by cutting the facial nerve in an

animal and producing the condition, thus solving an age-old problem. The experimental work on the elucidation of the nature of rickets and scurvy as being due to vitamin deficiency, on the discovery of drugs curative for streptococcal infections, such as puerperal fever and pneumonia, and on the nature of cancer, were described. Finally, Sir Edward pointed out both the importance and the limits of clinical observation, and discussed some of the criticisms and failures of the experimental method.

Early Cultural Relations in Central America

AMONG communications dealing with the archæology of Central America presented to the Twenty-seventh International Congress of Americanists, which met in Mexico City on August 5–15 (see NATURE, Aug. 19, p. 319), there were several, it would appear from a preliminary report issued by Science Service of Washington, which brought forward suggestions and advanced conclusions of considerable interest in reference to the cultural relations of, and cultural successions among, the early inhabitants of Mexico and the adjacent regions. Dr. Alfonso Caso, president of the Congress, for example, in describing the results of his excavations on Monte Alban, not only argued for the common origin of the culture of that site with that of the not far distant ruined city of Mitla on the evidence of architectural affinities, but also put forward the conclusion that three stages of development are to be distinguished, which can be linked respectively with the Archaic culture of Mexico, dating from before the Christian era, the Toltec of Teotihuacan, and the Aztec. Further, Dr. A. V. Kidder, reporting on his excavations in pit-tombs near Guatemala city, assigns their builders to a period corresponding with the middle period at Monte Alban, or when the great Toltec civilization of central Mexico was approaching its decline. It would appear that the pottery from the Guatemalan pit-tombs provides a key which links the tomb builders with other early cultures of tropical central America. Some light was also thrown on the development of agriculture among the early peoples by Dr. Pablo Martínez del Rio, who advanced the theory that agriculture may have had a more rapid rise in the New World than in the Old, on the ground that differences in methods of seed selection and cultivation speeded up results for the Indian farmer, so that it was not necessary to postulate, as some botanists have done, an extremely long period of development.

Electrical Development in Iraq

IN a paper communicated to the *Electrical Review* of August 18 by W. H. Peters of Baghdad, a review is given of the post-War development of Iraq. Both Baghdad, the capital city, and Basra, its modern seaport, were left electricity systems installed by the British Army during the occupation. Being war products, they were limited in capacity and of antiquated design. During the past fifteen years these supply undertakings have been transferred to concessionaries or to the Government. The most provincial of the centre towns have shown initiative in the promotion of schemes for small plants primarily to serve the requirements of the administrative authorities for fans and for street lighting. The largest supply undertaking is that in the capital city, Baghdad, the population of which is about 250,000. It is directed by the Baghdad Light and Power Co., which is registered in the United Kingdom. It is the only supply station left which is of foreign ownership. The main thoroughfares of the city are copiously lighted, the load exceeding 300,000 watts. The port of Basra set up an efficient power station five years ago and the sale of energy in the port and the municipal area which it supplies has exceeded all expectations. The rate at which it sells power is 4½*d.* per unit for lighting and 2½*d.* per unit for domestic power.

WITHIN a year the 'Iraqi State Railway will be finally completed to the northern city of Mosul and will permit of railroad goods traffic both westwards to Syria and southwards to Basra passing en route Basra, Baghdad, Syria, Turkey and so on to Europe. This great need once fulfilled is almost certain to develop the import and export trade of Mosul, thereby increasing its prosperity. Until three years ago all the Diesel power stations were run by plant entirely of British origin, but recently German plant has made considerable headway. Iraq's exports of oil and agricultural progress show a very satisfactory increase year by year and these contribute to increased national wealth and a higher standard of living. This increase in the standard of living is not confined to the property owners and married classes, but is apparent almost everywhere. It is noteworthy that Britain has hitherto enjoyed no commercial privileges in Iraq.

Coal Utilization by Electricity

ACCORDING to the *Electrical Review* of September 1, Mr. M. Anderson, the director of the Coal Utilisation Council, estimated that to keep the public properly warm would necessitate the consumption of eight million more tons of coal per annum. To raise the standard of 'heat comfort' was one of the principal aims of the plan of campaign outlined at the last National Coal Convention. Since the success of the campaign would depend largely upon the development of the domestic and industrial demand for electric power and especially that used for 'space heating', convenience rather than necessity would be the controlling influence in regulating the demand for coal for power. Mr. Anderson referred to several other methods of increasing the coal output to compensate for the falling off in the direct demand for coal owing to the increasing use of electric power and heating in many trades. Trolley buses, also, although they have greatly diminished the demand for electric tramways and in spite of the competition of oil-engine buses, have probably increased the total demand for electric power from the public mains and consequently for coal. Trolley-buses move faster and give a much better service than almost any other

vehicles. In many ways the interests of coal and its derivative electricity appear to be much the same. The demand by electric power stations on the collieries for 'slacks', 'duff' and rough 'smalls' now exceeds the supply, although coal-breaking and crushing plant has been installed at a number of collieries. This would naturally add to the cost of production.

Water-cooled Lamps for Television

A SERIOUS difficulty in television studios is the necessity of providing about double the light required by an ordinary cinema studio without subjecting the occupants and contents to intolerable heat. This difficulty has been largely overcome by the General Electric Co. of America at the television station at Schenectady, New York, by the use of a battery of four water-cooled quartz mercury arc units, containing twelve argon-filled lamps having a light output equivalent to that provided by nearly 30,000 watts of incandescent light, but they give off practically no appreciable amount of heat. According to the *Electrical Review* of August 25, the lamps are about the size of a cigarette and have an exterior of quartz. Surrounding the tube is another quartz jacket through which water passes at the rate of three quarts a minute, dispersing about 90 per cent of the heat generated. The twelve 1,000-watt lamps used have a total light output of about 800 thousand lumens, while the same wattage of incandescent lamps would provide only 330 thousand lumens. The possibility of a burn from incandescent lamps, caused by the infra-red radiation, greatly inconveniences performers who appear before the television camera. In the case of the new lamps, more than 90 per cent of the infra-red radiation is absorbed by the circulating water. The cooling system of the lamps is equipped with a pressure-operated switch and magnetic valve, since the water in the jacket must be moving before the lamp is lighted and because the lamp must be turned off automatically in the event of failure or reduction of the water supply. During operation a pressure of more than 1,000 lb. per sq. in. is developed within the quartz jacket.

Railway Electrification at Home and Abroad

ALTHOUGH the date of opening of the electrified route between Manchester and Sheffield has not yet been fixed, orders have been placed for seventy electric locomotives. This follows on the orders for eight multiple-unit trains between Manchester and Glossop. During the last two months a number of new electric services in Kent have been opened. According to the *Beama Journal* of August, the Southern Railway now possesses 3,189 electrically operated passenger vehicles, of which 603 cars have equipment designed for a maximum speed of 75 miles per hour and the remainder of 60 m.p.h. These speeds appear slow when compared with the rated speeds of Continental expresses. It must be remembered that the Southern Railway undertaking is a huge suburban network, in which high average speed is of the greatest importance. The problem of the London–Brighton railway is very different from that of the line joining Milan and Brescia. For the latter route an electric locomotive with a commercial speed of 94 m.p.h. has just been designed. In preparation for the forthcoming electrified link between Berlin and Munich, the German State Railways have accepted a locomotive with an ordinary speed of 112 m.p.h. and a possible maximum of 140 m.p.h. The use of locomotives of this type will, it is believed, reduce the journey time between Berlin and Munich from eight to five and a half hours.

Health of the Army in India during 1937

STATISTICS of the health of the British and Indian troops in India are contained in the recently issued "Annual Report of the Public Health Commissioner with the Government of India for 1937", 2 (Government of India Press, New Delhi. Rs. 2-6, or 4*s*.). The year 1937 was, from the health aspect, a good year for both British and Indian troops. There was a reduction in hospital admissions among both groups as compared with 1936 (also a good year) of 14·3 per 1,000 of strength among British troops, and 37·0 among Indian troops. Although the admission ratio appears to be on the downward trend, conditions cannot be considered satisfactory according to modern health standards so long as 568 out of every 1,000 British soldiers and 390 out of every 1,000 Indian soldiers are admitted to hospital during the course of a year. Compared with the troops in the United Kingdom, the hospital admission ratio in India is almost exactly double. The reasons are partly climatic, and partly due to the more primitive methods of sanitation, both in the army and among the civil populations in contact with it. There has been, however, a reduction in incidence of such diseases as malaria and the enteric groups of fevers. A new synthetic drug named 'Certuna' has given promising results in the treatment of sub-tertian malaria. Information is given of the work being done to supply pure water to the stations, on conservancy systems, and on the sanitary control of milk and foods.

Work of Indian Medical Institutes

THE reports of the Haffkine Institute for 1938 and of the Pasteur Institute of India, Kasauli, for 1937, have reached us. The Haffkine Institute is the centre for the preparation of Haffkine's preventive plague vaccine, of which 1,137,086 doses were issued during the year. Some trials of the Institute's anti-plague serum were made in a small outbreak of plague, with a mortality of about 26 per cent, compared with a mortality of about 63 per cent with other non-specific treatments. Two of the sulphanilamide drugs, Prontosil and M. and B. 693, so valuable in streptococcal infections, were tried in plague but showed little or no curative power. A number of research studies on plague vaccine and serum, anti-malaria drugs, human and rat leprosy, fleas, and other subjects are summarized. At the Kasauli Pasteur Institute, anti-rabic treatment is carried out. The total number of patients attending the Institute and its centres was 28,076, of whom

20,936 received the full course of anti-rabic treatment, with a mortality of 0·45 per cent. The vaccine employed was a carbolized 5 per cent emulsion of brain of sheep inoculated with Paris fixed virus. The deaths from rabies registered in 1937 in the Punjab and the United Provinces numbered 438.

Cosmic Data

Two valuable summaries of the data at present available as to the motion of the galactic system among the nebulæ and as to the sources of stellar energy are contributed by Dr. E. Hubble, of the Mount Wilson Observatory, Pasadena, and by Prof. H. N. Russell, director of the Princeton University Observatory respectively, to the August issue of the *Journal of the Franklin Institute*. With respect to the extragalactic nebulæ taken as frame of reference, the galactic system is moving with a speed of the order of 100–200 kilometres per second in the direction of the northern galactic latitudes. The sun is rotating about the centre of the galaxy with a speed of the order of 275 kilometres per second in the galactic direction latitude 0°, longitude 55°. The resultant is a speed of the order 300 kilometres per second in the direction latitude 35° north, longitude 55°. After pointing out that the reactions which provide the stars with their energy must be accompanied by a loss of mass, Prof. Russell summarizes the recent work of Prof. H. A. Bethe, of Cornell University, on the six steps by which the impact of four protons, that is, hydrogen atoms, on a carbon atom which acts as a catalyst lead to the production of a helium atom. Owing to the diminution of mass involved in the conversion, the process is capable of supplying the sun's energy if its temperature is of the order 18–21 million degrees centigrade, that of Sirius at 22 million and that of γ Cygni at 30 million, all of which temperatures are in agreement with astrophysical observations.

The National Central Library

The twenty-third annual report of the Executive Committee of the National Central Library refers to the way in which development has been hampered by the absence of sufficient funds. The only department which is able to provide anything like an adequate service is the Bureau of American Bibliography, recently established with the aid of a generous grant from the Rockefeller Foundation. The two main sources of income have been, as in previous years, the grants of £5,000 from the Treasury and £4,000 from the Carnegie United Kingdom Trust. Of the 10,825 volumes added to the library, 7,203 were presented; 46,715 books were issued to libraries and 11,968 to adult classes. The total number of outlier libraries is 135, consisting of 113 special libraries, 19 London borough libraries and 3 urban libraries, representing a stock of 4,201,000 volumes, from which 11,361 books were lent during the year. The regional library systems now cover the whole of England and Wales, embracing 479 libraries. During the year, 50,031 books were lent by libraries in regional systems to other libraries in their own system, and in addition 7,104 books were lent to libraries outside their own regional area through the National Central Library. Of the 3,538 books lent to university libraries, 1,846 were supplied by the National Central Library and its outliers, 1,536 by other university libraries, and 156 by foreign libraries. As against 508 books lent to libraries in 24 foreign countries, libraries in 16 foreign countries lent 283 books to libraries in the British Isles.

Data of Seismology

Valuable seismological data have just been received from India (Government of India, Meteorological Department, Seismological Bulletin, July–Sept. 1938). This publication contains readings of the seismograms received at the observatories of Agra, Bombay, Calcutta, Colombo, Dehra Dun, Hyderabad and Kodaikanal, together with non-instrumental reports. Readings from the Indian observatories are particularly important for the determination of the epicentres of earthquakes removed from North America, Europe and Japan, where the majority of the earth's seismological stations are situated. The non-instrumental reports indicate the occurrence of four local shocks in July, seven in August and six in September, some of which were followed by after-shocks. Silchar, Lahore and Kalat each reported shocks on two separate occasions.

Earthquakes during June 1939

According to the Central Seismological Bureau at Strasbourg, 132 earthquakes were registered by seismographs or felt by people during June 1939. The most on any one day was ten on June 4, and the least on any one day was one on June 25. Undoubtedly the strongest shock during June was that of June 22 on the Gold Coast, having an epicentre provisionally calculated to be 5·7° N., 0·7° W. The next three in intensity were June 18, felt scale 7 (Rossi-Forel) at Costa Rica, June 5 with epicentre in the Atlantic west of the Azores, and June 8 with possible deep focus (130 km.) in the Islands of Samoa. Other shocks for which provisional epicentres could be obtained were June 3, Tananarive (scale 2); June 4, north-west Australia and Arizona; June 6, Algeria; June 12, Porto Rico; June 23, near Apia; June 24, two in California; June 27, Philippines; and June 29, Vrancea. During June the Fort de France station registered eight local tremors.

New Fellows in Pure Research at Mellon Institute

Dr. R. S. Tipson and Dr. Warner Carlson have been appointed fellows in the Department of Research in Pure Chemistry in the Mellon Institute. Dr. Tipson was born in Derbyshire in 1906. He was awarded the degree of B.Sc. of the University of Birmingham in 1927 and then engaged in research on the carbohydrates under Prof. W. N. Haworth. Later he conducted an investigation, for the British Empire Cancer Campaign, on the preparation of tobacco tar and determination of its constituents. In 1929 he was appointed to a research fellowship in the department of industrial and cellulose chem-

istry, McGill University, Montreal, Canada, where, in collaboration with Prof. Harold Hibbert, he examined the structure of certain bacterial polysaccharides. He went to the United States in 1930 to become a research assistant to Dr. P. A. Levene on the staff of the Rockefeller Institute for Medical Research, New York, and in 1926 was promoted to the position of research associate. Dr. Carlson was born in Lincoln, Nebraska, in 1913. He pursued his early professional education at the University of Nebraska, from which he obtained the degree of B.S. in chemistry in 1933 and the degree of M.S. in the same field in 1935. A little more than a year was spent at the Iowa State College in biophysical chemistry, after which he transferred to the Ohio State University. At the latter institution he held a research fellowship in the Industrial Research Foundation, receiving the degree of Ph.D. in March 1939 with a thesis entitled "Physiological Studies on the Synthesis of Dextran by Bacteria of the Genus Leuconostoc".

Mathematical Tables

THE Works Progress Administration of the City of New York is undertaking extensive computation of mathematical tables. The work is sponsored by Dr. L. J. Briggs, director of the National Bureau of Standards, and is intended to give employment to clerical workers in New York. Several tables, including Bessel functions for complex arguments, exponential and trigonometric integrals, and the error function are completed or in active progress. Of the tables under consideration, the most noteworthy is a table of elliptic functions for complex arguments so designed as to cover a period parallelogram in each case.

Recent Sunspots

Two very large groups of sunspots have recently appeared. The first of these was a big single spot with companions increasing in size; the second group comprised a complex stream. Positions and areas are as follows:

Date on disk	Central meridian passage	Latitude	Maximum area
Aug. 25—Sept. 7	Sept. 1·0	15° S	3000
Sept. 4—Sept. 17	Sept. 10.5	15° S	2500

The areas are corrected for foreshortening and are expressed in millionths of the sun's visible hemisphere. An extensive bright eruption associated with the second group was observed at Greenwich on September 8 from 11h. 35m. until about 12h. 30m., the maximum being at 11h. 43m. U.T.

Announcements

THE printed addresses prepared in connexion with the Dundee meeting of the British Association, which include the presidential address by Sir Albert Seward, the addresses of sectional presidents, the first British and American Association Lecture, by Dr. Isaiah Bowman, on "Science and Social Pioneering", and Sir Richard Gregory's address as chairman of the Division for the Social and International Relations of Science entitled "Contacts of Religion and Science", can be obtained, temporarily, from the British Association, Down House, Downe, Farnborough, Kent, price 6*d*. each.

OWING to the outbreak of war, it has been necessary to postpone indefinitely the general discussion arranged by the Faraday Society on "The Electric Double Layer", which was to have been held September 25–27. It is at present hoped to publish the papers in an early issue of the *Transactions*.

THE National Emergency Blood Transfusion Service announces that registered blood donors in London and Greater London will be notified when they are required, and until then they need take no action. Donors having group *O* blood will be called upon first for blood to be stored for national use.

THE Joint Tuberculosis Council will hold a course in radiology at Shire Hall, Castle Hill, Cambridge, during September 20–22. A course in the diagnosis and treatment of pulmonary tuberculosis will be held at the Tuberculosis Office, 352 Oxford Street, Manchester, during October 10–14. Further information can be obtained from Dr. J. B. McDougall, Preston Hall, near Maidstone.

PROF. ALBRECHT SCHMIDT of Frankfort-on-Main and Prof. Johannes Stark, of the Physikalisch-Technischen Reichsanstalt, Berlin-Charlottenburg, have been awarded the Goethe Medal for Art and Science, and Dr. Karl Frik, director of the Werner Siemens Institute for Radiology in the Robert Koch Hospital in Berlin, has been awarded the Rieder Medal by the German Röntgen Society.

DR. GEORGE W. CORNER, professor of anatomy, University of Rochester School of Medicine, New York, has been appointed editor of the *American Journal of Anatomy* in succession to the late Dr. Charles R. Stockard.

THE issue of the *Medical Journal of Australia* for July 1 is a silver jubilee number containing articles on the progress of medicine, surgery, preventive medicine and medical journalism during the last twenty-five years.

AN institute for research in rural hygiene has recently been set up in a farmhouse at Lichtenstein in Bavaria, the birthplace of Max von Pettenkofer, the founder of experimental hygiene in Germany.

THE seventh International Congress on Rheumatism will be held in New York, Philadelphia and Boston during June 1–10, 1940. Further information can be obtained from the Ligue internationale contre le rhumatisme, Keizergracht 489, Amsterdam.

ACCORDING to official statistics, the population of Japan on October 1, 1938, was 72,227,700, or 969,000 more than in the previous year. Tokyo is the most populous city with 6,457,000 inhabitants.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 517.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Quantitative Comparison of the Biological Effects of Neutrons and other Ionizing Radiations

A CONSIDERABLE number of tissues have been exposed to very high energy Be-D neutrons (~ 12 Mev.) with the help of cyclotrons, in the United States. The published values of the ratio γ/N of the gamma-ray to the neutron doses for a given biological effect range from 2 to 8. These ratios should be comparable among themselves, but since the neutron doses were measured in arbitrary units they cannot, without further experiment, be regarded as indicating the ratio of the absorbed neutron and gamma-ray energy. Two investigations have been reported in which an attempt has been made to measure this quantity. Zimmer[1], using Li-D neutrons, found the ratio of gamma-ray to neutron energy necessary to produce the same increase in mutation rate in Drosophila sperm to be $\gamma/N = 0{\cdot}7$, whereas for the lethal effect on the bean root we[2] have found $\gamma/N = 11$. Comparable procedures were adopted for the estimation of the neutron energy absorbed in the tissue in the two cases, and these were roughly checked by the exchange of ionization chambers[3].

Before attempting any biological interpretation of such a striking difference in the sensitivity of bean roots to gamma-rays and neutrons we have considered whether any known physical process could increase the energy absorption of a given beam of neutrons in tissue appreciably above the value which we have estimated. This value takes into account the recoil atoms of hydrogen, carbon, oxygen, and nitrogen, which contribute respectively 92 per cent, 1·7 per cent, 5·2 per cent, and 0·4 per cent of the total estimated energy absorption, and the disintegration of nitrogen, which adds a further 0·4 per cent. The interaction of fast neutrons with nearly forty elements has been measured by various authors[4], including all elements, other than the inert gases, up to and including calcium. The energy absorbed per unit mass of the element by the process of nuclear recoil is maximum for hydrogen, and falls steadily to 1 per cent of this value for calcium, and 0·05 per cent for lead. In some cases, for example lithium, a single atomic disintegration together with the subsequent decay of the unstable nucleus, may liberate more than ten times as much energy as that of the average recoil hydrogen atom. Such atoms, however, are present in tissue in altogether too small amounts to make an appreciable contribution to the total energy absorption, and a careful study of the data makes it fairly certain that in the case of irradiation by D-D neutrons no atomic disintegration or induced radioactivity is likely to make a larger contribution than that estimated above for nitrogen.

Lest any of the minor atomic constituents of protoplasm had been overlooked, the matter was tested experimentally. Grass tips were incinerated with nitric acid so as to obtain a fifteen-fold concentration of the non-volatile constituents. This ash was strongly irradiated for thirty minutes and tested (*a*) by insertion into a large ionization chamber connected to a Lindemann electrometer, (*b*) by a Geiger counter, for induced radioactivity. Measurements were commenced 30 sec. after the end of the irradiation. Method (*b*) showed some radioactivity. By introducing uranium into the position occupied by the ash it was possible to estimate the energy liberation in tissue corresponding to any given observed activity and decay constant. This made it clear that there was no element of period greater than ~ 3 sec. present in the irradiated ash which, either during irradiation or the subsequent five days*, could make any appreciable contribution to the energy absorption in this tissue. To test for short-period activity the ash was applied as a thin layer to the inside of a small electron metal ionization chamber, with 15 per cent by weight of dextrin as a binder. When irradiated, the difference between the observed ionization and that to be expected from the chamber plus dextrin represented only 7 per cent of the total energy absorption in tissue.

We are thus unable to find any reason for supposing that our estimates of neutron energy absorption in tissue are seriously in error. Probably the explanation of the greatly increased sensitivity of certain tissues to neutron, as compared with gamma-ray energy, must be sought in terms of specific relationships between the distribution of ionization and biological structure. It is very desirable, however, first to know whether neutron and gamma-ray energy are equally efficient in producing simple chemical changes, and this we are in process of investigating.

We gratefully acknowledge the financial assistance of the British Empire Cancer Campaign.

L. H. GRAY.
J. READ.

The Mount Vernon Hospital and the Radium Institute, Northwood, Middlesex.
July 29.

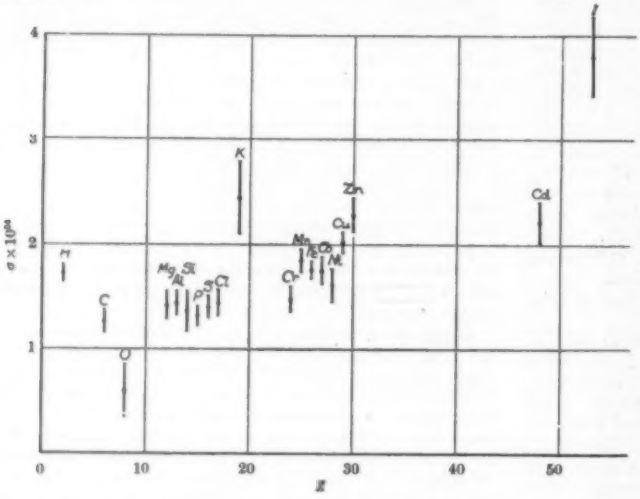
* The period during which the growth of the beans was observed.

[1] Zimmer, *Str. Th.*, **63**, 517; **63**, 528 (1938).
[2] Gray, Read and Mottram, NATURE, **144**, 479 (1939)
[3] Gray and Read, NATURE, **144**, 439 (1939).
[4] Ladenburg and Roberts, *Phys. Rev.*, **50**, 1190 (1936). Kikuchi and Aoki, *Phys. Rev.*, **55**, 108 (1939).

Scattering of D—D Neutrons

EXPERIMENTS hitherto performed on the scattering cross-sections of various substances for D—D neutrons have led to fundamentally different results. Most observers have found that the cross-section σ increases regularly with the atomic number, and some have deduced from their results the variation with Z of ξ, the 'sticking factor'. Kikuchi and Aoki and collaborators[1], however, have observed a periodic

variation of σ with Z. The detectors used in all these experiments have been either sensitive to fast neutrons of wide range of energy, or sensitive to slow neutrons. Since the 170 min. period of phosphorus is excited only by neutrons of energy greater than about 2 Mev., it is an ideal detector for D—D neutrons, especially as our experiments have shown that there is no observable elastic scattering of these neutrons by elements of widely differing atomic number such as sulphur, iron and lead. The disadvantage of the use of phosphorus, however, lies in its relatively low intensity of excitation, so that the detector had to be placed near (9 cm.) the target. In consequence the geometry was not ideal, and only relative cross-sections could be obtained. In spite of this, however, the mean free path in paraffin wax was the same to within experimental error as that observed by Booth and Hurst[2], among others, using better geometry and an indium foil as a slow neutron detector.



This result is the more curious in view of the fact that for the majority of the elements investigated the cross-section observed was roughly half of the value obtained by previous observers. While our results vary in accuracy between 5 and 15 per cent, the fine structure observed by Kikuchi and Aoki is roughly corroborated. A graph showing variation of σ with Z (so far as iodine) is given.

A fuller account of the experiments performed will be published elsewhere.

W. D. ALLEN.
C. HURST.

Clarendon Laboratory,
Oxford.
July 26.

[1] *Phys. Rev.*, **55**, 109 (1939).
[2] *Proc. Roy. Soc.*, A, **161**, 248 (1937).

Selective Oxidation of Aluminium Alloys

THE superficial film formed on heating an alloy in air consists usually of a mixture of oxides of the alloying metals. In some circumstances, however, the oxide of only one of the elements—often of a minor constituent—appears on the surface. This has been known for some time to be the case with oxidized surfaces of brass and stainless steels. Electron-diffraction investigations have lately furnished a considerable number of similar examples[1–4].

Experiments with some aluminium alloys have shown that selective oxidation in these alloys occurs with a hitherto unrecorded prominence. The alloys in question were aluminium-beryllium and aluminium-magnesium, they were oxidized in an electric furnace, in air at atmospheric pressure. The composition of the surface layers after oxidation was investigated with the aid of an electron-diffraction apparatus.

A 99·8 per cent aluminium 0·2 per cent beryllium alloy oxidized at 630° C. gave the electron-diffraction pattern of BeO; at lower temperatures the well-known diffuse Al_2O_3 pattern was recorded. So small an admixture of beryllium is thus sufficient to cause a layer of pure BeO to form on the surface, provided that the alloy is oxidized at a sufficiently high temperature. For an alloy containing 3 per cent of beryllium, the limiting temperature was 500° C. on surfaces oxidized at 500° C. and higher, BeO only appeared on the surface.

The selective character of oxidation of the surface of aluminium-magnesium alloys has already been recorded[1]. Preston and Bircumshaw found that MgO is formed on the surface of an alloy containing so little as 0·5 per cent magnesium. We were successful in extending this limit by producing a film of MgO on an alloy containing no more than 0·03 per cent of magnesium. The indispensable condition was to perform the oxidation just below the melting point of the alloy. The specimen was kept for twelve hours in a furnace where the temperature was maintained between 650° and 660° C. In the case of an alloy containing 0·1 per cent magnesium, an oxidation temperature of 620° C. was sufficient. With a 1·4 per cent magnesium alloy the surface layers consisted of MgO at 400° C.

In looking for an explanation of such striking facts as the formation of a layer of pure MgO on the surface of an alloy containing barely one atom of magnesium for about 3,000 atoms of aluminium, chemical arguments are of little help. As a matter of fact, the heat of oxidation of aluminium (namely, 190) is much greater than that of magnesium (143) or beryllium (131). 'Preferential' oxidation in the sense of greater chemical affinity of magnesium or beryllium for oxygen, or reduction of the previously formed Al_2O_3 by beryllium or magnesium, can thus scarcely be considered as a probable hypothesis.

The accumulation of ZnO on the surface of brass has been attributed by some investigators to the higher vapour pressure of zinc. The same might have played some part in aluminium-magnesium alloys. Beryllium, however, possesses a much higher boiling point than aluminium. Thus it would be expected that aluminium would have a higher vapour pressure at the temperatures at which oxidations were performed. Accumulation of BeO in surface layers cannot be explained, therefore, in this way either.

One of us has pointed out the important role of the surface tension of the constituents of an alloy in determining the composition of its surface layers[5]. Unfortunately, there are no data with regard to the surface tension of the three metals involved in these

investigations. This makes it impossible to predict which of the metals should be adsorbed on the surface. If we assume, however, that the difference of surface tensions is the cause of highly selective oxidation of aluminium-beryllium and aluminium-magnesium alloys, it is to be inferred that the surface tension of magnesium and beryllium is much lower than that of aluminium.

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Extremely Bright Spots on Coolidge Tube Target

WHILE making tests with a newly made Coolidge tube with molybdenum target, we discovered several bright spots of unusual brightness on its target surface.

(*a*) (*b*)

The accompanying illustration shows (*a*) photographs of the target when only the cathode of the Coolidge tube was heated, that is, while the X-rays were not being radiated, and (*b*) of the same target taken when a voltage of 50-cycle 40 kv. (peak value) was impressed on the anti-cathode and an electronic current of 20 mA. D.C. was flowing, that is, while X-rays were being radiated. In front of the lens of the camera, a right-angled glass prism was attached so as to prevent the X-rays being projected on the sensitized plate of the camera. In (*b*) several white spots will be seen, whereas in (*a*) no such spots exist. The photograph does not show these spots well; the actual bright spots glare quite intensely and look as if they were embossed on the target surface. The target of the Coolidge tube was continuously cooled with running water.

In order to ascertain whether these bright spots were produced during the half-cycle in which the electronic current follows, or during the other half-cycle, a stroboscopic observation was made, and it was found that they were produced only during the former half-cycle, and the larger the instantaneous value of current the greater the intensity. Furthermore, when the heating current of the cathode was kept constant, there was practically no change in the brightness of the spots, even when the anode voltage was lowered to a voltage such as 10 kv. (peak value), at which no radiation of the characteristic X-rays of molybdenum would take place; but when the heating current was varied, the brightness was greatly affected, these spots being nearly invisible when the electronic current was less than 10 mA.

From these results it would appear that the spots are due to electronic bombardment; in other words, due to a particularly intensified electric field at some minute protrusions accidentally existing on the target surface, the protruding points become incandescent. As clearly seen from the photographs, the surface of the target is not perfectly smooth; it is covered with scratches, as if the surface had been brushed over. These facts support the view put forward.

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A SIMILAR phenomenon to that described by Messrs. Koga and Tatibana has been observed during the course of certain research work on multi-segment magnetrons operating under rather abnormal circuit arrangements at about 80 cm. wave-length.

Brilliant points of luminescence have been observed on the rear surfaces of the anode segments, which are each in the form of a hollow tantalum triangle with one curved face receiving the electron stream, and generally running very hot, about yellow-white. The appearance of these spots of light was so distinctive that it was at first thought that holes had been formed in the anode rear surface, making visible the almost white-hot inner face. On examination, when not operating, it was seen that the anodes were not punctured, nor was it possible to account for such puncturing, although a 'cyclotron' effect has been observed giving a charge on a screen surrounding the anodes four times the voltage applied to the anodes.

It was found that a high output was needed before the spots appeared and the general order was about 400 watts radio frequency with the anodes dissipating about 175 watts. Furthermore, the spots were critical with regard to filament emission and also disappeared suddenly below 2,100 volts on the anodes, but were quite unchanged by large variations of voltage above this: a fact which is noticed by the Japanese investigators.

I remember noting several years ago similar effects in a Farnsworth cold cathode multiplier (photo-electric cathodes with focusing magnetic field) where flash-overs kept occurring, maybe due to the liberation of gas from an almost microscopic incandescent protuberance.

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Vitamin B_6 and Skin Lesions in Rats

VITAMIN B_6[1] has been defined[2] as "that part of the vitamin B_2 complex which is responsible for the cure of the specific dermatitis developed by young rats fed on a vitamin B-free diet supplemented with purified vitamin B_1 and lactoflavin" (riboflavin). The specific skin lesions ("rat acrodynia") are characterized by symmetrical dermatitis with œdematous, scaly skin, mainly on the most peripheral parts of the body, such as the mouth, nose, paws, ears and tail.

In a later study, Lepkovsky, Jukes and Krause[3] have shown that rats need a further factor, in addition to vitamin B_1, riboflavin and vitamin B_6, to supply the requirements for normal growth and development on a diet deficient in vitamin B. In the opinion of the authors mentioned, this additional factor corresponds presumably to the so-called chicken pellagra factor or the "filtrate factor"[4]. Addition of vitamin B_6 (called also Factor 1) alone did not permit growth in rats, and "some of the rats developed swollen eyelids which tended to stick together. The eyes were watery and the nose was inflamed"[3]. Addition of the filtrate factor (called also Factor 2) alone resulted in slow growth, and the rats developed the specific acrodynia-like skin condition. Addition of both Factor 1 and Factor 2 assured normal growth and development.

Apart from the sticky eyes and sore nose, the skin lesions were not attributed to deficiency of the filtrate factor but almost exclusively to that of vitamin B_6, which was regarded as the specific skin factor of the vitamin B_2 complex for rats, the skin lesions in riboflavin deficiency in rats being less conspicuous. Thus, the designation *adermin* has been proposed by Kuhn and Wendt[5] for vitamin B_6.

In a preliminary paper[6], attention has been directed to the fact that this conception was not borne out by direct experiments in which pure vitamin B_6 was substituted for the crude vitamin B_6 concentrate used by Lepkovsky, Jukes and Krause[3]. Admittedly, in rats suffering from acrodynia (with the exception of a few refractory rats), addition of 10 micrograms daily of vitamin B_6, natural or synthetic*, brought about improvement of the specific dermatitis and in many instances led to complete cure. In the further course of these experiments, rats often died from other internal deficiency diseases, such as panmyelophthisis, adrenal hæmorrhage, liver injury and kidney injury, the nature of which need not be discussed here. Later, in a large percentage of the remaining group of rats, there developed extreme and severe skin lesions which differed from those seen in acrodynia in rats. Three more or less distinct types of lesions were observed in this group of rats, which to date includes more than 100 animals.

Type I. The hair over the abdomen is matted together, appears damp and is sticky to the touch. There is loss of hair around the chin, nose and eyes and over the forehead between the ears. The sides of the cheeks and also the abdomen are often covered with scales, which are generally brown in colour. These scales may sometimes become quite thick. In advanced cases, the lids of the eyes seem to be inflamed and are sometimes kept closed, while the brown scaliness may extend over the sides of the forehead. Probably on account of irritation, the animals often rub the forehead and cheeks with the forepaws and thus transfer a coating of the brown scaly matter to the paws. There is emaciation and inanition.

Type II. After complete cure of the acrodynia, new lesions start around the mouth, the groin and the acillæ, in the form of inflammation and scale production. Later, alopecia follows, extending to the neck and over the back. Hyperæmia may be seen also on the ears, and the forepaws often become excoriated. In several animals generalized scaliness (exfoliative dermatitis) has been observed.

Type III, the rarest in our observation, corresponds to the descriptions given[3,7] of rats with watery eyes which stick together and sore mouth.

Concentrates of liver and yeast and filtrates from wheat germ, yeast and rice polishings, after adsorption on fuller's earth, in proper doses assure complete cure of all these skin manifestations.

In view of these results, the part played by the vitamin B_2 complex in dermatologic conditions has to be extended beyond vitamin B_6, and the term *adermin*, because it is misleading, should be abandoned. In accordance with the chemical nature of vitamin B_6, which is a pyridine derivative containing several oxy (methoxy) groups, the term *pyridoxin* appears to be appropriate.

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* Synthetic vitamin B_6 has kindly been put at our disposal by Merck and Co., Inc.

Influence of Glutamine on the Growth of *Streptococcus hæmolyticus*

IT has been recently demonstrated by McIlwain, Fildes, Gladstone and Knight[1] that glutamine is an essential growth factor for most strains of hæmolytic streptocci freshly isolated from pathological processes. By the use of glutamine, these investigators have been able to replace completely the hitherto essential meat extractives in their culture medium.

We have been able to confirm the work of McIlwain and his co-workers. Employing a strain of *Streptococcus hæmolyticus* isolated from a case of septicæmia which terminated fatally, good growth was obtained in a peptone base medium, similar to that used by McIlwain *et al.*, when it was supplemented with glutamine. Controls showed little or no growth. The specimen of glutamine used was prepared from natural sources by the method of Vickery, Pucher and Clark[2]. Under similar test conditions, glutamine exhibited a moderate growth-stimulating effect on several stock cultures of *Str. hæmolyticus*.

It is of considerable interest to recall the observations of Dart[3], who showed that beet juice contains

a powerful growth-stimulating hormone for *Str. hæmolyticus*. He was able to demonstrate a marked reduction in the 'lag phase' during the growth of this bacterium in beef infusion broth to which had been added 0·1 per cent beet juice. Since beets are a rich natural source of glutamine, the connexion is suggestive.

In an attempt to grow the freshly isolated strain of *Str. hæmolyticus* in a medium of completely defined chemical composition, including glutamine, the peptone in McIlwain's medium was replaced with an amino-acid mixture (Fildes[4]) frequently used in this laboratory for nutritional studies. No growth was obtained under these conditions, nor was growth observed when the peptone was replaced with acid-hydrolysed casein. In view of these findings, it seems likely that there is present in peptone another factor (or factors) which must be available before freshly isolated strains of *Str. hæmolyticus* can be cultivated in a medium of known chemical composition.

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Nature of a Group in Papain Essential to its Activity*

MUCH of the literature on the activation and inactivation of papain[1,2,3,4] supports the hypothesis that there is an essential SH group in the active enzyme.

The active crystalline enzyme[5], however, does not give a positive nitroprusside test or a satisfactory titration with porphyrindin[6]. Crystalline papain, like certain other proteins, was observed to give a positive nitroprusside test in the absence of cyanide only after denaturation. If, however, the native protein was first inactivated with iodoacetate, then separated from the excess of iodoacetate by precipitation with salt and finally denatured as before, no nitroprusside test without cyanide was obtained. In agreement with this observation, hydriodic acid was detected in the mother liquor from the salt precipitation. Titration of the denatured protein in urea solution by iodine gave results which indicate that only one sulphur group (of about ten in the papain molecule) is involved and that it disappears when the enzyme is inactivated by iodoacetate or cystine. This is supported by the observation that inhibition of papain activity is produced by one molecular equivalent of iodoacetate. Papain is still 'native' after reaction with cystine; that is, the solubility is apparently unaltered and the protein can still be crystallized.

It may be concluded that the SH group that appears on denaturation is blocked from reaction with some but not with all reagents while the protein is in the native state. Dr. M. L. Anson informed us by private communication that he has observed that SH groups in certain proteins react with iodoacetamide, but are not attacked by oxidizing agents.

* Food Research Contribution No. 448.

Results of titrating denatured papain SH groups with iodine are shown in the accompanying table:

Enzyme preparation	Treatment of protein	Equivalents of protein × 10^7		Equivalents of sulphydryl × 10^7	SH per equivalent of active protein
		Total	Active		
A	None	37	30	28	0·93
A	Iodoacetate	37	2	5	—
A	None	19	15	17	1·13
A	Iodoacetate	19	1	1	—
B	None	32	23	27	1·17
B	Cystine	32	10	11	1·1
B	Cystine	31	7·3	11	1·5
B	Iodoacetate	31	1	2	—

The equivalents of protein are calculated using a molecular weight of 30,000[7]. The enzyme preparation treated with iodoacetate contained 21 milk clotting[7] units of papain per mgm. of protein nitrogen when activated with cyanide, and the one treated with both cystine and iodoacetate contained 27 units.

After the native protein had been freed of the 5–10 fold excess of iodoacetate or the excess of solid cystine, it was denatured by heating at 70–75° C. for 10 minutes. The protein was centrifuged out, washed and finally dissolved in strong urea solution. This solution was treated essentially by the method described by Lavine[8] for the estimation of cystine except that the temperature was 0–5° C. The sodium thiosulphate solution was 0·01 *N*. The blanks agreed to within 0·02 ml.

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Glutamic Acid as a Hydrogen Carrier in Animal Tissues

IT has previously been shown that α-ketonic acids liberate carbon dioxide when added to animal tissues under anaerobic conditions[1]. The evolution of carbon dioxide was found to be due to a 'dismutation'.

(1) $2\,R.CO.COOH + H_2O = R.CH(OH).COOH + R.COOH + CO_2$.

We have now found that the anaerobic carbon dioxide formation from α-ketoglutaric acid in kidney and in heart muscle is greatly increased by the addition of ammonium chloride. The analysis of this effect showed that α-ketoglutaric acid 'dismutes' with α-iminoglutaric acid (which arises on addition of ammonium salt to α-ketoglutaric acid)[2] as follows:

(2) $COOH \cdot (CH_2)_2 \cdot CO \cdot COOH$ + (α-ketoglutaric acid)
$COOH \cdot (CH_2)_2 \cdot CH : (NH) \cdot COOH + H_2O$ (α-iminoglutaric acid)
$= COOH \cdot (CH_2)_2 \cdot CH(NH_2) \cdot COOH$ + (glutamic acid)
$COOH \cdot (CH_2)_2 \cdot COOH + CO_2$. (succinic acid).

For example, 17·9 mgm. sliced kidney cortex (rat) produced in 140 minutes in the presence of

0·02 *M.* α-ketoglutarate 0·02 *N.* ammonium chloride	0·02 *M.* α-ketoglutarate
327	136 μl carbon dioxide
222	80 μl succinic acid
234	81 μl glutamic acid

In the presence of molecular oxygen reaction (2) is followed by reaction (3).

(3) glutamic acid + $\frac{1}{2}O_2$ = α-ketoglutaric acid + NH_3;

and the net result of (2) and (3) is the oxidation of ketoglutaric acid to succinic acid and carbon dioxide:

$COOH.CH_2.CH_2.CO.COOH + \frac{1}{2}O_2 = COOH.CH_2.CH_2.COOH + CO_2$.

The system

glutamic acid ⇌ α-iminoglutaric acid

thus acts as a hydrogen carrier in the oxidation of α-ketoglutaric acid. It has been known for some time that, in kidney, ammonium salts increase the rate of oxidation of α-ketoglutaric acid and of those substances which may give rise to the intermediary formation of α-ketoglutaric acid, namely, glucose, lactic acid and pyruvic acid[3,4]. This may now be explained by the fact that ammonia, according to reaction (2), is required in the oxidation of ketoglutaric acid.

Reaction (2) was not observed in liver, pigeon brain or pigeon breast muscle. Several facts suggest, however, that glutamic acid (or glutamine) acts as a hydrogen carrier in these tissues also, but it is not yet clear from which substrates the hydrogen is accepted. Isocitric acid[5] and β-hydroxybutyric acid[6] which may donate hydrogen to iminoglutaric acid in artificial enzyme systems do not appear to react in the intact cells.

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Tarsiers in Captivity

SPECTRAL tarsiers have been maintained in captivity for varying lengths of time by a number of observers[1,2,3]; but only at stations actually within the area of their geographical distribution (Melanesia). No record has been found of this form reaching the zoological gardens of Europe or North America.

The present note relates to a pair of tarsiers that have been held under laboratory conditions at New Haven, Connecticut, for the past nine months. These specimens, a mature female and her presumptive offspring, a young male, were captured by Mr. J. S. Eckman at Barrio Bad-As, Province of Surigao, N.E. Mindanao, Philippine Islands, in July 1938. Mr. Eckman kept them as pets until October 1938 when, coming to the United States, he brought them at our request to Los Angeles, California, arriving in mid-November. From there they were at once shipped by air to New York, and were received at New Haven on November 18, 1938.

These animals have thriven in captivity, in spite of a somewhat less than ideal environment. During the winter the temperature of their room executed fluctuations ranging from 24° to 30° C., although we sought to maintain an average of 28° C. A crude humidifier was only partially successful. They are kept in a basement room with a north-western exposure, receive no sunlight, and only a low intensity of light. They have received, however, about 3 hours light every other day from a 'Sperti' ultra-violet lamp.

The only food which they have accepted with absolute consistency has been mealworms (Tenebrio larvæ), of which they have taken some 50–60 each per day. To a dish of this food have been added, every day or so, a little salt mixture and a few drops of cod liver oil. New-born mice were eaten, two or three a day each, for the first few weeks that we had the tarsiers; but these are now always refused. Nor will they touch raw beef or liver since becoming accustomed to the live food, and both fruit and milk are always rejected. The weight of the female increased rapidly from 164 gm. to a maximum of around 208 gm.; this probably represents weight regained plus certain fat deposition. The weight of the male has increased more steadily from 106 to 159 gm., most of which increase would appear to represent growth.

The tarsiers are kept in a large cage containing a smaller 'hide-out' cage to which they keep for the greater part of the day, and to which they rapidly retreat when frightened. They emerge around 6 p.m. and are feeding and very active until at least 4 a.m. Their reaction to the ultra-violet light is quite capricious; sometimes they come out and bask within a foot of it, at other times they seek to remain hidden.

The female has been observed to exhibit cyclical swelling of the external genitalia, coupled with a dramatic change in the cellular content of the vagina from the normal mixture of leucocytes and nucleated epithelial cells to complete or almost complete cornification of the epithelials with partial or complete disappearance of leucocytes. The times between the estimated peaks of these cycles have ranged from 23 to 28 days over six such cycles. A sufficiently intensive search for red blood cells in the vaginal lavage has not yet been made. The reproductive status of the male, who would now be somewhat more than a year old, is not known, although erections have been noticed.

Observations on other aspects of the special physiology and behaviour of the tarsiers are being continued.

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Formation of Cleistogamic and Chasmogamic Flowers in Wild Violets as a Photoperiodic Response

IN the spring of 1938, an investigation was undertaken to study experimentally the physiological conditions for cleistogamy in violets. It seemed obvious that the results of Bergdolt[1] do not offer a satisfactory explanation of the occurrence of this phenomenon in Nature. Nutritional difficulties are not likely to occur suddenly and so regularly as to account for the seasonal appearance of cleistogamic and chasmogamic

flowers. As a matter of fact, most of his experiments also indicate an influence of the photoperiod. Curiously enough, Uphof[2] in his review of cleistogamic flowers overlooked the influence of this ecological factor, although a detailed investigation by Allard[3] showed the decisive effect of the photoperiod for the formation of cleistogamic and chasmogamic flowers in the hog peanut (*Falcata comosa*). Garner and Allard[4] also report on the influence of day-length actually for a species of violet (*Viola fimbriatula*).

Consequently I considered it appropriate to make a detailed study on the influence of the photoperiodical response on wild violets. My assumption has proved correct with regard to flower-formation. I have investigated the effect with the following species: *Viola biflora, canina, hirta, odorata, mirabilis, palustris, riviniana, silvestris*. Different species need different lengths of day. As a general rule, however, photoperiods less than twelve hours produce no flowers; with photoperiods between 13 and 15 hours, chasmogamic flowers normally appear; and when the photoperiod exceeds 17 hours, cleistogamic flowers appear. Additional morphological reactions have been observed. The plants have been grown in pots under identical conditions and the various flower types appear regardless of the season. Cleistogamic flower-buds fall off when transferred to a shorter photoperiod. Chasmogamic buds differ in the reaction to prolonged day-lengths. The induction of rejuvenation and everblooming responses are being investigated, and the study will be extended to elucidate the modifying effect of other ecological factors.

These results give a probable explanation of the fact that violets commonly flower for the second time in the autumn, and that cleistogamic flowers occur regularly in the summer. Most likely this photoperiodic reaction accounts partly for the fact that the alpine violets mainly are chasmogamic (Schroeterer[5]), while cleistogamy is a conspicuous feature of the violets in the northern countries and especially in the Scandinavian mountains (Lindman[6]). Other factors, especially the existence of different ecotypes, must however also be taken into consideration.

A detailed account of these experiments will be published later.

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Genetical Proof of the Existence of Coffee Endosperm

In the last few years several opinions have been published regarding the nature of the nutritive tissue of the coffee seed. Houk[1] came to the conclusion that the bulk of the mature coffee seed is perisperm formed by an enlarged nucellus, the scantily formed endosperm being evanescent. In a second paper[2] the same author puts forward the view that nucellus and integument of the ovule are so intimately fused that they cannot be distinguished from each other. This hypothesis of the 'integument-nucellus' had already been proposed by Lloyd[3]. Mayne[4] does not agree with Houk's assumption, and states that endosperm formation passes through a long rest period shortly after fertilization; meanwhile the nucellar tissue develops, evolving the true endosperm; later on, however, the endosperm begins to grow rapidly, replacing the nucellar tissue, which in the mature seed is represented by the inner layer of the 'silver skin'. Leliveld[5] confirms von Faber's[6] opinion, that the coffee ovule contains a very small nucellus "surrounded by a single stout integument". As the seed develops, the nucellar tissue is supposed to be suppressed and the integument enlarges, surrounding the embryo-sac. Endosperm formation is induced later on; it then takes all the space in the seed, the remnants of the integument finally forming the silver skin. The author claims to have determined the triploid nature of the endosperm by actual chromosome counts. Joshi[7] also agrees with von Faber that the ovule of coffee "has a weakly developed nucellus and a massive integument"; but he seems to agree with Houk that the nutritive tissue of the coffee seed is of maternal origin.

In the present note, we wish to put forward a genetical proof for the existence of true endosperm in the mature coffee seed. A few years ago a new mutant of *Coffea arabica* L. called 'Cêra'[8], which differs from the normal *Coffea arabica* varieties by having *yellow* seeds, was found in two coffee-growing regions of the State of São Paulo. Cutting through a mature seed, one notes that the whole of its nutritive tissue is of that colour. Yellow seeds are easily distinguished from normal green coffee beans. A genetical analysis of this new character, as yet not complete, furnished the following preliminary results:

(*a*) plants grown from *yellow* 'Cêra' seeds produced seeds of the same colour when the flowers were selfed;

(*b*) pollinating flowers of these plants with pollen of normal *green* seeded individuals (*C. arabica* L.), *green* hybrid seeds were always produced; the colour of these hybrid seeds cannot be distinguished from that of pure green seeds;

(*c*) pollinating flowers of 'Cêra' plants with pollen of *C. excelsa* Chevalier and *C. liberica* Hiern., which also have *yellow* seeds, hybrid seeds of the same colour were always obtained.

The results of (*b*) prove that a typical case of xenia occurred, one gene (or genes) for green colour dominating entirely two genes (or more) for yellow colour derived from the polar nuclei of the embryo-sac.

As the production of green hybrid seeds in the crosses between 'Cêra' type and normal green-seeded varieties is not likely to be explained by the occurrence of metaxenia, it is concluded that the bulk of the mature coffee seed is formed by real endosperm.

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June 1.

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Natural Variances of Mental Tests, and the Symmetry Criterion

WHEN two correlation matrices R_1 and R_2 have a *symmetrical* product $R_1R_2 = R_2R_1$, they have the same latent vectors[1,2], and Prof. Cyril Burt has recently proposed[3] to use this as a criterion that two batteries of mental tests contain the same mental 'factors'. I do not myself think that one can draw any safe conclusions about identity of factors in two batteries unless some tests are common to both batteries. But if one accepts Burt's criterion, I wish to point out that when R_1R_2 is asymmetrical, the product of the *covariance* matrices $D_1R_1D_1$ and $D_2R_2D_2$ may conceivably be symmetrical, where D_1 and D_2 are diagonal matrices of standard deviations. If an experimenter therefore has psychological reasons for thinking that two batteries contain identical factors, but finds R_1R_2 to be asymmetric, he may be able to discover variances which would make the product $D_1R_1D_1D_2R_2D_2$ symmetric. In that case he would have considerable reason for assuming these to be the natural variances of these tests.

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August 7.

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Effect of Tube-Length on the Visibility of Dust Particles with an Oil-immersion Objective

THE phenomenon described by Messrs. Beadle and Patterson in NATURE of August 19, p. 327, is well known to practical microscopists, since it occurs whenever a considerable change in the working aperture of a wide-angled objective is made, and admits of a simple explanation.

It is generally admitted that the perfect correction of all the zones of a high aperture oil-immersion objective for spherical aberration is a practical impossibility. It is therefore usual for the computer to concentrate on the inner and outer thirds of the aperture, leaving an intermediate zone in which the corrections are less accurate. When adjusting the tube-length for such an objective under full aperture conditions, the predominating rays for which symmetry of defocusing is obtained are those from the two preferred zones mentioned above.

In the case of the examination of objects mounted dry upon the cover, and of such a nature that no stray light is reflected or refracted into the portion in excess of N.A. 1·0, the first and intermediate zones only are in use, and since the corrections for the rays from the latter will but rarely coincide exactly with those for the outer zone, a change in tube-length will almost certainly be required. The extent of this alteration, and whether plus or minus, will depend entirely on the skill and inclination of the computer, and the figure given by Messrs. Beadle and Patterson of minus 20 mm. to 30 mm. cannot therefore be regarded as having any scientific significance.

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Dipterous Larvæ and Wound Treatment

DURING the war of 1914–18, W. S. Baer[1], in the United States, noticed that when troops wounded in battle had been lying out on the ground unattended for some time, their wounds very commonly became infested with larvæ of certain kinds of flies. He noticed specially that when the wounds had acquired about their maximum maggot population they did not exhibit dangerous after-effects. On the other hand, men whose wounds had received prompt early treatment often developed infection. It was found that the presence of these larvæ was especially beneficial in cases of osteomyelitis. It was discovered that the larvæ were eating the necrotic tissue which was supporting the main bacterial infection, and at the same time these larvæ were inhibiting further bacterial growth. Stewart[2] claimed that the scavenging larvæ play an important part in clearing the necrotic tissue, but that calcium carbonate, which is constantly excreted by the larvæ, is also important in alkalizing the medium (the wound) in which the bacteria live, and of increasing phagocytic activity.

The larvæ used in the earlier treatment of osteomyelitis belonged chiefly to the species *Lucilia sericata* (Meig.), *L. cæsar* (L.) and *Phormia regina* (Meig.). Stewart[3] showed, however, that due precautions must be taken, and a proper knowledge of the biology of these larvæ is essential. Some species will feed on both necrotic and normal tissue and are potentially dangerous to the latter.

Much study has been devoted to the technique of rearing dipterous larvæ under aseptic conditions, and also of retarding their normal development until they were actually needed for implantation within wounds. Sterilization of the eggs in a 5 per cent solution of formaldehyde mixed with a 1 per cent solution of sodium hydroxide for five minutes has been found satisfactory by Robinson[4]. The full details of this process, and that of the subsequent rearing of the larvæ, is given by the last-named author. Livingston and Prince[5] were successful in eliminating the inconvenience and unpleasantness associated with the actual 'maggot therapathy' by using a sterile extract of the creatures themselves. Robinson[3] claimed that the blow-fly larvæ contain allantoin in their excretion, and that the rapid healing of wounds as the result of 'maggot therapathy', is due in the main to this agent. He did not claim, however, that it could be entirely substituted for the application of the living larvæ. Robinson carried his investigations further and found that a watery solution of allantoin provides the necessary healing agent, without the presence of dipterous larvæ at all. In 1935 allantoin was a rare chemical in the laboratory, but it soon came to be made synthetically. Robinson also pointed out that a part of the allantoin molecule can be split off by hydrolysis to form urea. Further work led to the discovery that a 2 per cent water solution of urea has the equal healing properties of allantoin or of the fly larvæ themselves. It has the further advantage of being much cheaper than allantoin.

Not only osteomyelitis, but also many other kinds of non-healing wounds, have been treated in the manner just described, including gangrene, heat burns, X-ray burns, varicose and diabetic ulcers, etc. So far as I am aware, Paramonow in 1934[7] was the first to use dipterous larvæ in the treatment of gas gangrene. He applied maggots of the house fly, *Musca domestica*, since Calliphora larvæ were prone to devour healthy as well as necrotic tissue. He

states that he cured three cases of gas gangrene when amputation appeared inevitable, and that the healing process set in 48 hours after the treatment began.

In this brief summary, I have stated the present position of the subject in so far as it is known to me. It is desirable, at the present early stage in the world calamity that we are facing, that the foregoing information should be made as widely known as possible. There is no doubt that further research into the technique of this method is urgently required. Also, I believe that it is correct to say that this method of wound treatment has been more widely explored in the United States than in England. The literature on the subject is already extensive, and I have only mentioned a few of the chief writings here.

Zoological Laboratory, Cambridge. Sept. 7. A. D. IMMS.

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Points from Foregoing Letters

In view of the large apparent difference between the sensitivities of bean roots to neutrons and γ-rays, a search was made by L. H. Gray and J. Read for possible contributions to the energy absorption in tissue resulting from neutron irradiation, such as induced radioactivity. The activity induced in ashed grass was measured experimentally, and was found to correspond to a quite inappreciable contribution to the total energy absorption. The difference in sensitivity to neutrons and γ-rays is therefore considered to be real.

The scattering cross-sections of various elements for D—D neutrons have been measured by W. D. Allen and C. Hurst, using phosphorus as a fast neutron detector The cross-sections thus observed are smaller than those obtained by previous experimenters.

The superficial oxide films formed on aluminium containing small admixtures of beryllium or magnesium are found by S. Dobiński and M. Niesłuchowski to consist in most cases of BeO or MgO, even when the additional element is present at so low a concentration as 0·03 per cent in the case of magnesium.

When testing a new Coolidge tube with molybdenum target, I. Koga and M. Tatibana observed brilliant spots and scratch markings on the target while X-rays were being emitted. They suggest that the spots are due to electronic bombardment of minute protrusions from the surface of the target. Jan Forman describes similar appearances which were noted when using multi-segment magnetrons under certain conditions; the luminescent points were on the backs of the anode segments. He has also seen a similar effect in a Farnsworth cold cathode multiplier.

According to results obtained by P. György and R. E. Eckardt, the part played by the vitamin B_2 complex in dermatologic conditions has to be extended beyond vitamin B_6. In the presence of vitamins B_1 and B_6 and riboflavin, three further types of dermatologic conditions were observed.

M. Landy has confirmed earlier work by other investigators, who showed that some strains of hæmolytic streptococci can be grown on a peptone base medium supplemented with glutamine; but when the peptone is replaced by a stock amino-acid mixture frequently used for nutritional studies, he finds no growth, suggesting that peptone contains a necessary growth factor.

A. K. Balls and H. Lineweaver state that the exposure of crystalline papain to iodoacetate, or for longer periods to cystine, resulted in the disappearance of sulphhydryl as determined by a titration with iodine on the later denatured protein. The loss corresponded approximately to one –SH group per molecule of the enzyme protein inactivated by the reagent. Qualitative tests for –SH with nitroprusside in the absence of added cyanide were positive only on denatured protein that had not been treated with iodoacetate or cystine. The results permit the conclusion that an –SH group or the precursor thereof is essential to the enzymic activity of papain. It is also evident that native proteins exist for which the nitroprusside test is not informative.

H. A. Krebs and P. P. Cohen describe a 'dismutation', between α-ketoglutaric and α-iminoglutaric acids leading to the formation of glutamic acid, succinic acid and carbon dioxide. The reaction is an intermediary process in the metabolism of heart and kidney.

H. R. Catchpole and J. F. Fulton give an account of the first recorded survival of the spectral tarsiers in captivity outside the area of their normal distribution (Melanesia). A pair were brought from Surigao in the Philippines to New Haven, Conn., U.S.A., in November 1938, and they are now thriving under laboratory conditions. The female is mature and has exhibited regular œstral cycles of 23–28 days duration.

The photoperiodical response of several Swedish violas has been studied experimentally by G. Borgström. It seems that chasmogamy and cleistogamy are due to different photoperiods. When the photoperiod is less than 15 hours chasmogamic flowers normally appear, and when exceeding this day length cleistogamic flowers occur. Several additional morphological responses have been observed. These results partly account for the occurrence of these different flower-types in Nature.

G. H. Thomson points out that Burt's symmetry criterion for identity of mental factors in two batteries of tests, if accepted, may conceivably enable the natural variances of such tests to be ascertained.

A mutant coffee growing in Brazil has seeds which are yellow throughout. Pollination of these plants with normal green-seeded coffee produces hybrid seeds which are green, according to C. A. Krug and A. Carvalho. It is inferred that true endosperm constitutes the bulk of the mature coffee seed.

RESEARCH ITEMS

Two Bronze Age Cairns in Wales

THE report on the excavation by Sir Cyril Fox of the Simondston and Pond Cairns, Coity Higher Parish, Bridgend, Vale of Glamorgan, which appeared originally in *Archæologia* (87, 129–180, 1938), has now been issued in reprint as a publication of the National Museum of Wales (Cardiff: 1939, pp. 51, 2*s*. 6*d*.). Of the two cairns, that at Simondston is the earlier, its primary deposits in 'enlarged food vessels' indicating a date in Middle Bronze Age A, about 1500 B.C.; while the Pond cairn is definitely later, the deep collar of its well-wrought cremation urn belonging to Middle Bronze Age B, say 150 years later, or about 1300 B.C. Both cairns being situated on Lias limestone, the economic basis of their makers was similar, depending on a forest growth, mainly ash and other trees demanding calcareous soil, such as was widely occupied in neolithic and bronze age times in the Vale. The differences between the culture of the Simondston cairn and that of the Pond cairn are so profound that the latter must be regarded as intrusive in the district, while the former represents an ancient cultural tradition, the megalithic. The Pond cairn culture seems to be that of settlers from the other side of the Severn sea. Co-operation with workers in other fields of science (of which the results are here printed in appendixes) have produced results which indicate that the suggestion that the time had come to intermit for a period field-research on 'round barrows' was premature. Thus the present investigation has produced the first scientifically controlled record of wheat in the bronze age of Britain, the earliest record of barley, the identification of the charcoals of the fuels used for pyres and other purposes, and evidences of the use of coal in the bronze age in South Wales.

Standards of Physical Development in School Boys

IN view of the lack of standards based on recorded measurement of groups of adolescents, whose home environment, health record, and heritage present favourable conditions, an investigation was undertaken by H. Bathurst Norman of 500 public school boys, who in every case exceeded the standard required of the nutritive elements for the maintenance of perfect health, and for purposes of comparison, a homogeneous group of 501 secondary school boys, such as those among whom, according to current reports, the diet compares unfavourably with that of public school boys. The age groups range from thirteen to nineteen years; and the height, weight, sitting height, lumbar pull, and chest girth in expiration and inspiration were recorded (*Lancet*, August 19). There are significant differences in the results of the two groups. At each year between the ages of fourteen and eighteen a boy of Group I is approximately 16 lb. heavier and 3 in. taller than a boy of Group II. His lumbar pull is 30 lb. greater. The difference in height is shown, by measurement of sitting height, to be due to difference in the length of leg; while a record of ratio of weight to height shows a greater weight per unit of height in the public school group. The differences in physique are maintained roughly throughout the age periods under review. There is no progressive deterioration in the secondary school boy, nor any obvious tendency in the higher ages to approximate to the older of the public school boys. There is no abnormal acceleration of growth in either group. Heredity is an important influence in determining stature, but the real correlation is one of diet rather than of inherited genes. The limits of growth are due to heredity; but how nearly the limits are approached depends upon a variety of environmental conditions, of which correct nutrition during the growing period is one of the most important.

Penaeids of the John Murray Expedition

DR. RAMADAN has recently described an interesting series of Penaeids (excluding the genera Benthesicymus and Gennadas of the sub-family Aristaeinæ) (Crustacea: Penaeidæ. British Museum (Natural History), The John Murray Expedition 1933–34. Scientific Reports, 5, No. 3; 1938). The material is rich, and besides this a number of Penaeidæ in the collection of the British Museum material obtained by the German Deep Sea Expedition and other specimens have been examined for comparison. The descriptions are critical and detailed. A key is given to the genera of the Aristeæ, the chief distinction being the presence or absence of a hepatic spine on the carapace and the presence or absence (or reduction) of podobranch on the third leg and epipodite on the fourth. Seven (or perhaps eight) species of Aristeus are known, four of which, including two new species, are represented here. In discussing the genus Plesiopenaeus (p. 50) the author contradicts himself, for in paragraph 1 it is stated that *P. edwardsianus* does not possess exopodites on the walking legs, whilst in paragraph 3 they are stated to occur in this species. Again, on p. 51 it is inferred that they are absent. As Bouvier distinctly says that exopodites on the walking legs are absent in *P. edwardsianus*, the first statement is almost certainly correct and the second a slip; but an important slip in this case when the validity of the genus Aristeopsis is involved. Dr. Ramadan agrees with Burkenroad that Aristeopsis should be regarded as a synonym of Plesiopenaeus.

White Rot of the Elm

THE fungus *Ustulina vulgaris* causes the rotting of several kinds of forest trees, and its depredations have formed the subject of a recent series of papers by Mr. W. H. Wilkins. He has lately considered the parasitism of the organism upon elm (*Trans. Brit. Mycol. Soc.*, 23, Pt. 2; July 1939), and proved its pathogenicity by isolation of the fungus and re-infection. The sap-wood of the host is not attacked; but cells of the heart-wood apparently lose their starch and become discoloured, though no fungal hyphæ have been found. Patches of diseased wood occur, however, delimited by a black line, and hyphæ occur within this zone. It is suggested that parasitism of the fungus occurs in two stages, namely, infiltration, where products of the organism diffuse into healthy heart-wood, and cellular disintegration, which progresses only in the presence of the fungus. The disease is similar to a white rot of the lime, caused by the same pathogen.

Rayleigh Waves in an Inner Stratum of the Earth

K. Sezawa and K. Kanai, by mathematical calculation (*Bull. Earthq. Res. Inst., Tokyo*, 17, Pt. 2, 179–189; 1939) have determined several properties of Rayleigh waves such as can exist and be transmitted through an inner stratum of the earth. Some of the more important of these properties may be summarized as follows. In every case the velocity of the boundary waves ranges between the velocity of distortional waves in the stratum and that in the adjacent media. In the case of the displacement distribution of the waves that is symmetrical with respect to the middle plane of the stratum, there is only one dispersion curve for any ratio of μ' to μ. In the case of the distribution that is anti-symmetrical with respect to the middle plane, there are in general a number of dispersion curves for certain ratios of μ'/μ. These dispersion curves correspond to the waves of the fundamental and higher order types, namely, waves with several nodal planes of vibration parallel to the stratum. Yet even in the case of waves of anti-symmetrical vibration, if the velocity of distortional waves in the stratum is higher than that in the outer media, there is only one dispersion curve that corresponds to waves of fundamental vibration. The ordinates of the dispersion curves at abscissa $kH = 0$ represent the velocities of Stoneley waves that are transmitted along any one boundary between the inner layer and the outer media.

Magnetic Observations in Sweden

We have just received the second part of the report of the general earth magnetic investigation which was carried out during the period 1928–34 by the Geological Survey of Sweden. The first part of the report was published in 1936 under the title "A General Earth Magnetic Investigation of Sweden. Part 1—Declination S.G.U. Ser. Ca. No. 25", and this second part, which is No. 29 of the same series, entitled "Inclination", was compiled by Dr. Kurt Molin. Older determinations have been taken into account, as have also the measurements made by the Hydrographic Service of Sweden, but the chief part of the work has been done by seven persons on twenty expeditions. There were 2,257 observation places with an average of one I point in 177 km.^{2} and a rather greater density in Skåne. Dip circles were used throughout. For the mountainous districts, on account of its lightness, Chasselon dip circle No. 84 having a needle 6·5 cm. long was used, but owing to this not being so accurate as the other dip circles such as the Dover 8·9 cm., Casella 8·7 cm. and Gambey 25 cm., it was not used after 1931. An account of the corrections made and the method of reduction of the observations to the main epoch 1933·5 is given, together with explanatory maps and graphs. The main inclination table covers 42 pages, giving in each case the name of the station, latitude, longitude from Stockholm, altitude, geology, date of observation, values of dip in 1928·5, number of observations, average error, inclination in 1929·5 and 1933·5, and 1933·5 observed-calculated values. Four very valuable and beautiful colour-printed maps appended give: (1) inclination for epoch, July 1, 1933, (2) lines of equal anomaly, (3) values of anomaly of inclination, and (4) anomaly of inclination of Skåne. Since Sweden is interested economically in her iron ore deposits, this publication should be particularly valuable to Swedish authorities although it also affords a very valuable addition to the data of terrestrial magnetism and geology. Investigators interested in greater detail than it has been possible to give in this Swedish publication may obtain transcripts or photographic reproductions of the complete tables from the Geological Survey of Sweden.

Hydrolysis of Alkyl Halides

Considerable controversy has centred around the interpretation of the rates of hydrolysis of alkyl halides by neutral water, one hypothesis assuming a slow dissociation of alkyl halide into halide ion and organic cation with an incomplete valency shell (an 'open sextet'), followed by the rapid reaction of this cation with water to yield alcohol and hydrogen ion, whilst the other hypothesis postulates that the rate-determining step is a bimolecular reaction of a water molecule with alkyl halide to yield halide ion and a cation the valency shell of which is completed by co-ordination of a previously unshared electron pair of a water molecule. R. A. Ogg, jun. (*J. Amer. Chem. Soc.*, 61, 1946; 1939), has reviewed the energetics of the various reactions and finds that the dissociation of an alkyl halide (in aqueous solution) into a methyl ion with an 'open sextet' and a halide ion is endothermic by at least 50 k. cal. per mol, and more probably by 70 k. cal. On the other hand, reaction with water to yield halide ion and the co-ordinated methyl ion $CH_3OH_2^+$ is practically thermoneutral. Comparison with the experimental data for methyl halide hydrolysis shows that the first hypothesis stated (involving CH_3^+) is much less probable than the second (involving $CH_3OH_2^+$). It is suggested that carbonium ions with an open sextet never play an appreciable part in observable organic reactions and that mechanisms involving such ions should be abandoned.

Vitamins K_1 and K_2

The antihæmorrhagic vitamins have recently been isolated in a condition of demonstrated purity and some work on the degradation of vitamin K_1 has been reported, so that preliminary suggestions as to their structure have been made. The evidence from the degradations is incomplete and in some points uncertain, so that L. F. Fieser, W. P. Campbell and E. M. Fry (*J. Amer. Chem. Soc.*, 61, 2206; 1939) have made some synthetic studies of quinones related to vitamins K_1 and K_2. The quinonoid character of the two vitamins was reported by Doisy, and it now appears that the absorption spectra of the vitamins resemble those of 1,4-naphthoquinones more closely than those of other series. Such a structure would account for a number of properties of the substances, and the chemical properties and absorption spectra of synthetic model compounds, as well as the marked antihæmorrhagic activity of 2,3-dimethyl-1,4-naphthoquinone (assayed by the Almquiss procedure), lend support to the formulation of vitamin K_1 as 2-methyl-(or ethyl) 3-phytyl-1,4-naphthoquinone and of vitamin K_2 as 2,3-difarnesyl-1,4-naphthoquinone. The purple colour reaction of β-unsaturated alkyl naphthoquinones with sodium ethylate is shown to involve the replacement of the unsaturated side chain by hydroxyl, which accounts for the formation of a phthiocol-like pigment as the end-product of the colour reaction with vitamin K concentrates, and the pigment is probably phthiocol or the ethyl homologue. The phthiocol isolated from human tubercle bacilli may have arisen from the alkaline cleavage of a K-type vitamin.

SOCIOLOGICAL ASPECTS OF THE CINEMA

THE sociological and psychological importance of the film was under review in four papers at the first meeting of the Psychology Section of the British Association at Dundee on August 31. The discussion ranged from the film tastes of the adult to the uses that could be made of the film in the classroom, and in this connexion the question was raised whether sufficient attention is being given to the possible uses of the cinema apart from entertainment.

Knowledge of its manifold uses is so meagre that a suggestion was put forward for the creation of a Cinema Research Institute with an income of £50,000 a year. The objects of such an institute would be to co-ordinate to their mutual advantage the conflicting viewpoints of the various sections of the trade; to equate the demands of the public with the financial, technical and artistic resources of the industry, and lastly to use modern methods to discover the uses to which films could be put in the service of the modern democratic and world community. Its work would also be of value to Government Departments, official and semi-official bodies, municipal authorities, transport concerns, advertisers, social workers, and last but not least to the cinema industry itself.

The first investigation which it was suggested should be carried out was a general market research. There has never been any attempt to classify cinema-goers by age, sex or social categories. All that is known to-day is that the total number of regular cinema-goers in Great Britain in normal times is between 16 and 17 millions per week, with another 7 millions a week of more occasional visitors.

The second task a Cinema Research Institute should undertake is a research into the likes and dislikes of audiences by trained observers. The makers of films have certain 'hunches' that such and such a film will be a success, but the intuition is based on empirical calculations alone. Such an investigation would also doubtless show that the motives for attendance at the cinema are various. There are those who go to the 'pictures' for escape; the suburban housewife, for example, or the clerk or the manual worker slaving away at a monotonous job. There are, too, the courting couples who have no more interest in the pictures on the screen than in the man in the moon and to whom the comfort and isolation of the cinema is infinitely preferable to the chill of the city streets or the hardwood chairs and continuous interruptions of their own homes. Then there are those who go for an evening of good family entertainment on a regular day each week.

None of these groups is highly critical of the content of the films which they see. On the other hand, since receipts from films vary considerably, there must be a large but unknown number of people who pick and choose their film entertainment. Some go to see a particular star; others to see a dramatization of a play or a novel of which they have heard and which they think they will enjoy upon the film. Others go because their friends say that it is a good picture. Others because they have seen a good review in the 'fan' press or enjoyed the 'trailer' shown the week before. Lastly, there are the few who go to the films because they are interested in films as an art form similar to the theatre or music.

The last line of research that ought to be immediately undertaken is one into the film sociological and psychological effects. What, for example, will be the effect in international relations and political thought of the new tendency of the American film-makers to inject political propaganda into the films now being put upon the public screen? How far should the film be used for domestic government propaganda? The documentary or realist films sponsored by great interests like gas, oil or the General Post Office, are cases in point. "Housing Problems" directs attention to the need for better houses; "Enough to Eat" to problems of nutrition; "The Londoners" to the system and importance of local government; "Men in Danger" to industrial disease; or the American-made film "The River" to the Tennessee Valley Authority's work.

Nevertheless, in some respects all films have propagandist effect. The young people of to-day are better turned out than they used to be, and homes are more comfortable, all because of the effect of the film. Where one should draw the line between conscious and unconscious attempts to influence the filmgoer, is a question yet to be resolved. So far as the British public is concerned, direct propaganda rarely succeeds unless it is camouflaged as 'interest'.

The 'interest film' is capable of much further development. Both adults and children will stand for a great deal of education provided that it is not too obvious. Almost any pill will be swallowed if nicely coated with jam! Where so many amateur organizers of children's matinées go wrong, is that they bore their audiences and hence the experiment is unsuccessful. The professional children's matinée such as is run by some 700 picture houses in Great Britain is entertainment pure and simple. It consists of a good action film or serial, a cartoon sufficiently simple for children to understand, and an interest short film and a comedy. Dr. Inglis, of the University of Glasgow, made a plea for the film, which he said is not nearly so bad as it is painted, for it gives the children a love of adventure and a sense of beauty. It certainly has no effect on juvenile crime. In fact, closing these theatres would be likely to lead to an increase in anti-social conduct.

Side by side with the use of the film as children's entertainment runs the use of the film as one of the optical aids for children's instruction. Its value as a teaching aid has been abundantly proved. Films enable children to retain facts longer, open up the wider world around the child and, last but not least, instruct them in citizenship.

The reception given to this year's discussion emboldens one to suggest that the cinema is worthy of more than a sectional discussion and the committee might well consider if next year it should not form a topic for one of the evening lectures, perhaps under the auspices of the Division for the Social and International Relations of Science.

OLIVER BELL.

SOCIAL BIOLOGY AND POPULATION IMPROVEMENT

IN response to a request from Science Service, of Washington, D.C., for a reply to the question "How could the world's population be improved most effectively genetically ?", addressed to a number of scientific workers, the subjoined statement was prepared, and signed by those whose names appear at the end.

The question "How could the world's population be improved most effectively genetically ?" raises far broader problems than the purely biological ones, problems which the biologist unavoidably encounters as soon as he tries to get the principles of his own special field put into practice. For the effective genetic improvement of mankind is dependent upon major changes in social conditions, and correlative changes in human attitudes. In the first place, there can be no valid basis for estimating and comparing the intrinsic worth of different individuals, without economic and social conditions which provide approximately equal opportunities for all members of society instead of stratifying them from birth into classes with widely different privileges.

The second major hindrance to genetic improvement lies in the economic and political conditions which foster antagonism between different peoples, nations and 'races'. The removal of race prejudices and of the unscientific doctrine that good or bad genes are the monopoly of particular peoples or of persons with features of a given kind will not be possible, however, before the conditions which make for war and economic exploitation have been eliminated. This requires some effective sort of federation of the whole world, based on the common interests of all its peoples.

Thirdly, it cannot be expected that the raising of children will be influenced actively by considerations of the worth of future generations unless parents in general have a very considerable economic security and unless they are extended such adequate economic, medical, educational and other aids in the bearing and rearing of each additional child that the having of more children does not overburden either of them. As the woman is more especially affected by child-bearing and rearing, she must be given special protection to ensure that her reproductive duties do not interfere too greatly with her opportunities to participate in the life and work of the community at large. These objects cannot be achieved unless there is an organization of production primarily for the benefit of consumer and worker, unless the conditions of employment are adapted to the needs of parents and especially of mothers, and unless dwellings, towns and community services generally are reshaped with the good of children as one of their main objectives.

A fourth prerequisite for effective genetic improvement is the legalization, the universal dissemination, and the further development through scientific investigation, of ever more efficacious means of birth control, both negative and positive, that can be put into effect at all stages of the reproductive process—as by voluntary temporary or permanent sterilization, contraception, abortion (as a third line of defence), control of fertility and of the sexual cycle, artificial insemination, etc. Along with all this the development of social consciousness and responsibility in regard to the production of children is required, and this cannot be expected to be operative unless the above-mentioned economic and social conditions for its fulfilment are present, and unless the superstitious attitude towards sex and reproduction now prevalent has been replaced by a scientific and social attitude. This will result in its being regarded as an honour and a privilege, if not a duty, for a mother, married or unmarried, or for a couple, to have the best children possible, both in respect of their upbringing and of their genetic endowment, even where the latter would mean an artificial—though always voluntary—control over the process of parenthood.

Before people in general, or the State which is supposed to represent them, can be relied upon to adopt rational policies for the guidance of their reproduction, there will have to be, fifthly, a far wider spread of knowledge of biological principles and of recognition of the truth that both environment and heredity constitute dominating and inescapable complementary factors in human wellbeing, but factors both of which are under the potential control of man and admit of unlimited but interdependent progress. Betterment of environmental conditions enhances the opportunities for genetic betterment in the ways above indicated. But it must also be understood that the effect of the bettered environment is not a direct one on the germ cells and that the Lamarckian doctrine is fallacious, according to which the children of parents who have had better opportunities for physical and mental development inherit these improvements biologically, and according to which, in consequence, the dominant classes and peoples would have become genetically superior to the underprivileged ones. The intrinsic (genetic) characteristics of any generation can be better than those of the preceding generation only as a result of some kind of *selection*, that is, by those persons of the preceding generation who had a better genetic equipment having produced more offspring, on the whole, than the rest, either through conscious choice, or as an automatic result of the way in which they lived. Under modern civilized conditions such selection is far less likely to be automatic than under primitive conditions, hence some kind of conscious guidance of selection is called for. To make this possible, however, the population must first appreciate the force of the above principles, and the social value which a wisely guided selection would have.

Sixthly, conscious selection requires, in addition, an agreed direction or directions for selection to take, and these directions cannot be social ones, that is, for the good of mankind at large, unless social motives predominate in society. This in turn implies its socialized organization. The most important genetic objectives, from a social point of view, are the improvement of those genetic characteristics which make (*a*) for health, (*b*) for the complex called intelligence, and (*c*) for those temperamental qualities which favour fellow-feeling and social behaviour rather than those (to-day most esteemed by many) which make for personal 'success', as success is usually understood at present.

A more widespread understanding of biological principles will bring with it the realization that much more than the prevention of genetic deterioration is to be sought for, and that the raising of the level of the average of the population nearly to that of the highest now existing in isolated individuals, in regard to physical wellbeing, intelligence and temperamental qualities, is an achievement that would—so far as purely genetic considerations are concerned—be physically possible within a comparatively small number of generations. Thus everyone might look upon 'genius', combined of course with stability, as his birthright. As the course of evolution shows, this would represent no final stage at all, but only an earnest of still further progress in the future.

The effectiveness of such progress, however, would demand increasingly extensive and intensive research in human genetics and in the numerous fields of investigation correlated therewith. This would involve the co-operation of specialists in various branches of medicine, psychology, chemistry and, not least, the social sciences, with the improvement of the inner constitution of man himself as their central theme. The organization of the human body is marvellously intricate, and the study of its genetics is beset with special difficulties which require the prosecution of research in this field to be on a much vaster scale, as well as more exact and analytical, than hitherto contemplated. This can, however, come about when men's minds are turned from war and hate and the struggle for the elementary means of subsistence to larger aims, pursued in common.

The day when economic reconstruction will reach the stage where such human forces will be released is not yet, but it is the task of this generation to prepare for it, and all steps along the way will represent a gain, not only for the possibilities of the ultimate genetic improvement of man, to a degree seldom dreamed of hitherto, but at the same time, more directly, for human mastery over those more immediate evils which are so threatening our modern civilization.

F. A. E. CREW, C. D. DARLINGTON, J. B. S. HALDANE, S. C. HARLAND, L. T. HOGBEN, J. S. HUXLEY, H. J. MULLER, J. NEEDHAM, G. P. CHILD, P. R. DAVID, G. DAHLBERG, TH. DOBZHANSKY, R. A. EMERSON, C. GORDON, J. HAMMOND, C. L. HUSKINS, P. C. KOLLER, W. LANDAUER, H. H. PLOUGH, B. PRICE, J. SCHULTZ, A. G. STEINBERG, C. H. WADDINGTON

CONTACTS OF RELIGION AND SCIENCE

SIR RICHARD GREGORY, in choosing "Contacts of Religion and Science" as the subject of his chairman's address prepared for the Division for the Social and International Relations of Science for the Dundee meeting of the British Association, selected from the many topics of discussion open to him the one which, perhaps, most consistently holds the interest of those who are laymen in the double application of the term. He could have rendered no better service in both provinces of thought than he did by clarifying the issues, which in the popular mind are so frequently, but as Sir Richard maintained, erroneously held to conflict.

At the very opening of his address Sir Richard made his point of view clear when, after defining religion as "the reaction to an inner impulse as to what is conceived to be sacred and arouses awe or reverence", and science as "the accumulation of knowledge of the properties of natural objects—animate and inanimate—in relation to man's needs and his understanding of them through the use of his intelligence", he went on to show that there can be no conflict between them when they are conceived as joining in a higher unity, in which "all who are searching earnestly for truth, are considered to be worshipping at the same shrine". The dogmatisms of a few generations ago, both of men of science and theologians, are now giving way to a more liberal spirit. As he said, "The study of science creates a feeling of infinite greatness in all who pursue it, and though it may lead to imperfect interpretation, its motive cannot be irreligious. . . . It is in the service of high ideals that science, without which we cannot live, and religion, without which most people see no meaning in life, can find a common field of action."

When Sir Richard had thus made clear his conception as a man of science of the relation between religion and science, he proceeded in a brief historical survey to show what had been in fact the interactions of religion and science. Making special reference to the science of astronomy, he traced these relations from their beginnings in primitive forms of society, through their development in the civilizations of Mesopotamia, Egypt, India, the cosmogonies of the Greeks, the beginnings of modern scientific astronomical and physical knowledge down to Darwinism and the development of the theory of evolution, "which placed man in a new relationship to the rest of living creatures".

In regard to evolutionary theory, or rather its mechanism, the struggle for existence, Sir Richard was at pains to point out the erroneous character of the view sometimes put forward that this is a striving after personal or national mastery at all costs—"a crude misconception repudiated alike by its founder, and by Huxley, its most powerful exponent, as contrary to the best ends of civilization". Further, man as "Nature's insurgent son", continually fighting against forces of evil which would destroy him, is yet able to survive by the use of his intelligence. "He may not know the reason for his existence, but he does know that there is a law and order in the natural world, and if he breaks them, the penalty is inevitable. He has to obey the laws of Nature in order to survive."

Lest the charge of materialism should be brought against him for such doctrine, Sir Richard went on to show in effect that no break in the logical chain of argument, such as is sometimes imputed, is required to find a place for faith in such a view of Nature. For while "science is unable to provide any positive evidence for survival of personality after death—that belief is a powerful ethical factor in human development. It is just as permissible, therefore, to assume that another world awaits habitation by an

exalted type of humanity after this earth has come to an end, as it is to believe in the eternal existence of personality."

In conclusion, Sir Richard once more emphasized the historical note. The attempts to find support for Christian belief in general, and the Mosaic account of Creation in particular, in naturalistic or rationalistic explanations, or those which aimed at fitting new knowledge into a system of thought having no claims to scientific accuracy, served no useful purpose to the Bible or to science. A much sounder basis was to be found in applying evolutionary principles to religious thought and studying sacred books as stages in man's progressive discovery in theology. In science there are no final interpretations or unchangeable hypotheses; and when the same principle is recognized in theology, religion will share some of the vitality of the natural sciences. "It is through the acceptance of the idea of evolution in the spirit, as well as in the body of man, that the partition which formerly separated religion and science is being dissolved."

THE ANCESTORS OF THE EUTHERIA

By Dr. A. A. Abbie, Department of Anatomy, University of Sydney

WHATEVER may be the opinions of individual investigators, or even of groups of investigators, as to the status of the ancestors of the eutherian mammals, there has not as yet appeared any conclusive evidence which can determine the issue in favour of any one of the several theories available. Dentition, placentation, details of the skeleton and other somatic characters have all alike failed to supply a decisive solution to the problem. The ancestors may have been amphibians, reptiles, monotremes or marsupials; the Eutheria may have been derived together with the Prototheria and the Metatheria from a common ancestor; or the placentals may own one ancestor, the monotremes and marsupials another; or they may all have arisen independently from distinct pre-mammalian ancestors.

At the present moment any of these propositions could be advanced with little fear of contradiction, although a general consensus of opinion would probably be found to favour descent of the Eutheria from some primitive, marsupial-like predecessor.

While bearing in mind Graham Kerr's caution against building too much upon the evidence of a single system, it may be asserted, nevertheless, that in the brain there appears a structure—the corpus callosum—which is peculiar to the Placentalia[1,2,3], and that if the conditions essential to the formation of a corpus callosum could be defined with sufficient precision, they would provide a guide to the structure of the brain in the ancestor of the Eutheria.

Elliot Smith presented the view that the corpus callosum is produced by infiltration of the dorsal part

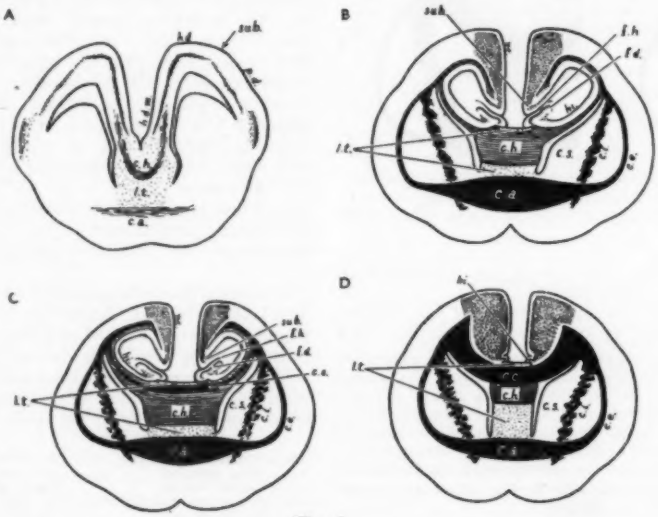

Fig. 1.

A, SECTION THROUGH THE BRAIN OF A REPTILE, TILIQUA, TO SHOW THE COMMISSURES AND THE POSITION OF THE FASCIA DENTATA, HIPPOCAMPUS AND DORSAL PALLIUM.

B, C, D, STAGES IN THE EVOLUTION OF THE CORPUS CALLOSUM ACCORDING TO ELLIOT SMITH: THE NEOCORTICAL FIBRES ARE SAID TO PASS THROUGH THE HIPPOCAMPAL COMMISSURE VENTRAL TO THE HIPPOCAMPUS.

(For key to lettering, see end of article).

of the hippocampal commissure with neocortical fibres which pass ventral to the hippocampus (Fig. 1, *B*, *C*). The hippocampus above the callosum then atrophies to the attenuated remnant which is represented chiefly by the indusium griseum (*C*). Elliot Smith expressed the opinion that the new neocortical connexion had been imposed upon the hippocampal commissure of marsupials, but a glance at *A* will indicate that it might as readily have been imposed

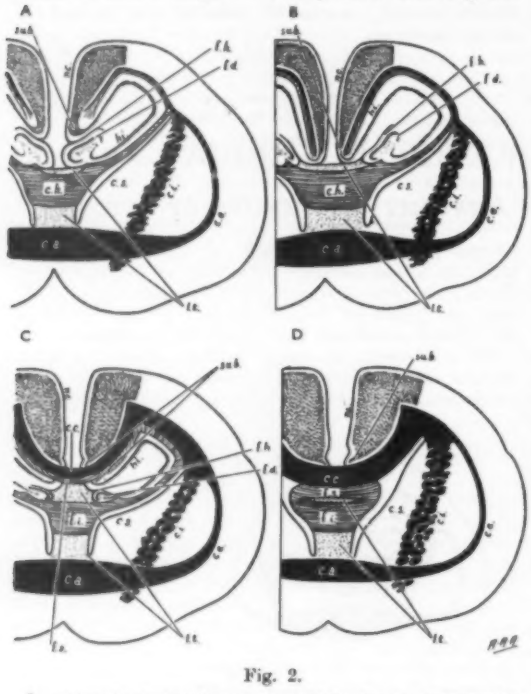

Fig. 2.

A, SECTION THROUGH THE BRAIN OF A MARSUPIAL, PERAMELES.

B, C, D, STAGES IN THE EVOLUTION OF THE CORPUS CALLOSUM ACCORDING TO THE VIEW PRESENTED HERE.

Note that the callosal fibres pass through the subiculum dorsal to the hippocampus, and then across the lamina terminalis; note also the formation of a fornix superior from the dorsal alveus fibres. The hippocampus is ultimately suppressed between the two fornix commissures in this region. Stages B, C, D are all readily demonstrable in the brain of a simple insectivore such as Erinaceus. All figures semi-schematic. (For key to lettering, see end of article.)

upon that of reptiles—or even of amphibians, for that matter. His work, then, left the problem no closer to solution than before.

It has been shown[3] that in reality the corpus callosum has appeared in quite a different manner. The neocortical fibres do not pass ventral to the hippocampus and through the hippocampal commissure; on the contrary, they pass through the subiculum dorsal to the hippocampus, separating this from the neocortex (Fig. 2, *A*, *B*, *C*). Thus the supra-callosal structure is really a lip of subiculum everted by the pressure of the issuing callosal fibres (*D*). Incidentally, these neocortical fibres carry on their ventral aspect some of the dorsal alveus fibres from the hippocampus to form a second hippocampal commissure—the fornix superior.

The callosal fibres, then, pass directly through the medial wall of the hemisphere at the subiculum, and cross on the dorsal aspect of the lamina terminalis to reach the opposite hemisphere. In the submammalia the subiculum is far removed from the lamina terminalis, its representative being found probably on the dorso-lateral aspect of the hemisphere (Fig. 1, *A*). It is clear that an essential preliminary to the production of a corpus callosum in the manner just described is approximation of the subiculum to the lamina terminalis. Such approximation is achieved when expansion of the neopallium produces the characteristic inrolling of the hippocampus with the formation of a hippocampal fissure; at this stage of evolution the subiculum lies at the apex of the dorsal lip of the hippocampal fissure[4] in close anatomical relationship with the lamina terminalis (Fig. 2, *A*).

Expansion of the neocortex and the consequent formation of a hippocampal fissure are the minimum essentials to the production of a corpus callosum, and this condition is first realized in the brain of monotremes and marsupials. The ancestor of the Eutheria must, therefore, be sought in these two groups of mammals, not among the pre-mammalia.

The ancestors of the monotremes are little known, while the brain in existing representatives of this group is far too specialized to serve as a starting point for the Eutheria. Among marsupials, the possession of a fasciculus aberrans in the anterior commissure[5,6] immediately excludes all Diprotodontia. Of the Polyprotodontia, such representatives as the Cænolestidæ and Peramelidæ, Myrmecobius, Notoryctes, Sarcophilus, Thylacinus and some of the Didelphiidæ are all too specialized in other directions to serve as possible candidates, and there remain only some of the Didelphiidæ and Dasyurinæ, and the Phascogalinæ. Finally, assuming that the possession of a pouch constitutes another bar to direct ancestry, the ultimate choice must fall upon some small pouch-less phascogale or didelphid of bodily structure sufficiently generalized to approximate that of the insectivore-like primitive placentals.

A word of personal explanation is probably required. The late Sir Grafton Elliot Smith was my teacher and friend, and what I know of science I learnt from him; but he was a man in whom scientific accuracy outweighed all personal considerations, and this paper is published in the knowledge that were he still alive, such would have been his wish.

c.a., anterior commissure
c.c., corpus callosum
e.s., external capsule
c.h., hippocampal commissure
c.i., internal capsule
c.s., corpus striatum
f.d., fascia dentata
h., hippocampal fissure
i., fornix inferior
f.s., fornix superior
h.d., dorsal hippocampus
h.d.m., dorso-medial hippocampus
hi., hippocampus
l.t., lamina terminalis
ne., neocortex
p.d., dorsal pallium
sub., subiculum

[1] Smith, G. Elliot, "The Origin of the Corpus Callosum—A Comparative Study of the Hippocampal Region of the Cerebrum of Marsupialia and Certain Cheiroptera", *Trans. Linn. Soc. Lond.*, 2nd Ser., Zool., **7**, 47 (1897).

[2] Smith, G. Elliot, "Some Problems Relating to the Evolution of the Brain", *Lancet*, 1, 147, 221 (1910).

[3] Abbie, A. A., "The Origin of the Corpus Callosum and the Fate of the Structures Related to it", *J. Comp. Neur.*, **70**, 9 (1939).

[4] Abbie, A. A., "The Relations of the Fascia Dentata, Hippocampus and Neocortex, and the Nature of the Subiculum", *J. Comp. Neur.*, **69**, 307 (1938).

[5] Smith, G. Elliot, "On a Peculiarity of the Cerebral Commissures in Certain Marsupialia, not hitherto recognized as a Distinctive Feature of the Diprotodontia", *Proc. Roy. Soc.*, **70**, 226 (1902).

[6] Abbie, A. A., "Some Observations on the Major Subdivisions of the Marsupialia, with Especial Reference to the Position of the Peramelidæ and Cænolestidæ", *J. Anat.*, **71**, 428 (1937).

A MESOLITHIC SETTLEMENT IN SURREY

THE discovery of a mesolithic village at Farnham, Surrey, was due in the first instance to Mr. W. F. Rankine, who established the fact of mesolithic occupation on the Farnham Valley Sewage Farm in 1929 in the course of a surface survey of the district. Trial excavations were carried out during 1930–35. Mr. J. G. D. Clark, recognizing the importance of the site, then undertook its systematic investigation. Excavations were carried out by him in 1937–38, Mr. Rankine co-operating. A report on the results of the excavations has been prepared under their joint authorship and is now available[1].

The village is situated to the north-east of Farnham on the gravel of the old course of the Blackwater at a height of 250 ft. above O.D. Water supply and geographical conditions combined to make the site attractive to early man, as is indicated by the discovery of archæological remains of many periods, ranging from Neolithic to Romano-British.

The trial excavations revealed the existence of some eighteen depressions in the gravel, some rich in worked and burnt flints, and most of them between three and four feet deep. The area selected for intensive work was a small rectangle showing less evidence of surface disturbance than other parts of the site. Here in 1937 three pits were discovered. These had a reddish-brown soil infilling, rich in worked and burnt flints. From Pit I, nowhere more than three feet in depth below the modern surface, some 851 crackled and more than 3,464 worked flints were recovered, while in a fourth pit, located and cleared in 1938, in which the floor had been cut through the gravel into red clay, 10,709 worked flints and 3,880 burnt flints were found. This pit was shown to be situated in a sandy hollow in the nature of a swallow hole, into which flints had been swept in mesolithic times. Flints were recovered to the number of 12,135 worked and 6,847 calcined. No significant differences in type were shown by flints from different levels. Evidences of Neolithic B occupation were found, but it is clear that the swallow hole had been choked with sand before neolithic peoples settled on the mesolithic site.

The size and contents of the pits and their general characteristics do not allow any doubt that they were dug as the floors of dwellings by the people whose worked flints were found in them. They were evidently intended for occupation over a considerable period of time; and in this connexion the existence of a permanent water-supply near by must be remembered. The excavation of these floors by their makers provided a certain amount of soil to serve for walls, on which roofs could be placed; but the irregular plan of the pits and the absence of post-holes argue against any kind of rigid frame construction. In regard to character and purpose, or mode of occupation, comparison may be instituted with the dwellings of Upper Palæolithic age investigated in Russia and Siberia and the earth-houses of recent circumpolar peoples.

Typological analysis of the flint implements found indicates a homogeneous industry, consisting of various types of microliths, of which slightly more than 30 per cent are geometric, flakes, scrapers, awls, burins, and core tools. Two techniques are to be noted, one core and the other flake. In the latter, microliths account for two-thirds of the whole.

Farnham is one of a number of sites in the area, extending to Aldershot, Guildford, Haslemere, and Bentley, on which the culture is essentially the same. Study of its distribution indicates the importance of geologico-ecological factors, and emphasizes the importance of water, and a subsoil of gravel or sand. Extending the survey to the south and east in Surrey, Sussex and parts of Kent, it would appear that the mesolithic sites are predominantly situated on the U-shaped band of Lower Greensand which surrounds the Weald, taking in sites at Dorking, Reigate, Redhill, and so far as East Malling, near Maidstone. A mace from Blackdown, now in the Haslemere Museum (and similar finds elsewhere), resembles a form from the heart of the Maglemose culture, which goes back to Boreal times. It is, therefore, evident that Farnham, Silmeston, Horsham, and other closely related sites form a group of industries differing in detail, but having in common features not found in combination elsewhere. They occupy a well-defined geographical area on analogous geological formations; and they therefore belong to a narrowly distributed but self-standing culture, for which the term Horsham culture has been proposed.

The key to the wider affinities of the Horsham culture is afforded in its combination of microlithic and core-axe elements—a combination which can be matched only in the Maglemose culture. While, however, the Maglemose strain must be recognized, certain differences must be admitted. The proportion of core axes is lower in relation to the microliths; and the microlithic forms are more varied. The microliths resemble most closely the Middle Tardenoisian of north-east France and Belgium. The Horsham culture, then, must be regarded as being basically Maglemosian, with a strong influence from Middle Tardenoisian. It is known that Maglemose spread over land now submerged, leaving outliers above modern sea-level in Holderness, East Anglia, the valley of the Thames and its tributaries, and probably the Isle of Wight and its hinterland. It was no doubt on the fringe of this territory on the western verge of the Maglemose culture-spread that the Middle Tardenoisian entered Britain; and it can scarcely be a coincidence that the Horsham culture, showing elements from both, is situated precisely in the zone of contact between the two.

Throughout history Britain has benefited from a variety of movements and influences from a variety of Continental sources. Already in mesolithic times two separate influences are to be seen flowing into England, one predominantly northern and the other predominantly western in character. The Horsham culture typifies the development of the British people which, drawing its inspiration from many sources, has yet managed to acquire its own distinctive features.

[1] *Proc. Prehist. Soc.*, **5**, 1; 1939.

SCIENCE NEWS A CENTURY AGO

The Acoustics of Buildings

ON September 18, 1839, George Goodwin, jun., wrote to the editor of the *Civil Engineer and Architects' Journal*: "Sir. The report recently made to the Commissioners of Her Majesty's Treasury, by Messrs. Barry, De la Beche, W. Smith and Charles Henry Smith, on the sandstones, limestones and oolites of Great Britain . . . forms with the numerous tables and results of experiments by Messrs. Daniell and Wheatstone appended to it, one of the most valuable contributions to architectural science that has been made in modern times. . . .

"This being the case, then it must, I think, seem desirable to all that government should continue the good work . . . and I would venture to suggest touching the next step to be taken, the importance of appointing a committee to inquire into the most desirable forms of buildings, and the best mode of construction in a phonocamptic point of view, to investigate the science of sound and to deduce principles to be hereafter applied in the erection of buildings. On this subject, which is of the most vital importance to the excellence of the new houses of parliament, we are confessedly entirely ignorant (and I speak of not architects *alone*), we do not know so much as would enable one to say with certainty before a building be finished, whether or not it will be well adapted for oratorical purposes. . . . Sincerely therefore do I hope that a commission will be immediately appointed to collect information on the subject, and conduct a series of experiments on a large scale, without which nothing effectual can be looked for. . . ."

Chemical Powers of Light

"M. EDMOND BECQUEREL has recently communicated to the Académie des Sciences some important investigations on the chemical powers of solar light, which will probably lead to new and valuable results. It has been long known that light has the power of variously affecting certain chemical compounds; sometimes causing combination between two elements, and in other cases effecting the decomposition of compound substances; and it has been found that when a pencil of light is decomposed by passing through a prism of glass, those rays which possess this power are differently refracted from the coloured rays, and hence the existence of peculiar rays to which the name of Chemical Rays is given, has been deduced. The chief difficulty in experiments on these rays has been the slow nature of the action caused, and the difficulty of appreciating them. M. Becquerel has overcome these sources of uncertainty, and is enabled to study the chemical powers of light with ease, and measure the effects produced with considerable accuracy. The manner in which this is done is very simple. Two liquids of different densities, but both conductors of Electricity, and of such a nature as to act chemically upon each other when exposed to the influence of solar light are selected, and a portion of both is put into a cylindrical vessel blackened on the exterior". Plates of platinum are immersed in the liquids and connected to a delicate galvanometer. "If when thus arranged a ray of light is suffered to pass through the mass of the fluid, it causes chemical action to take place at the surface of contact of the two liquids, and a current of electricity which this sets in circulation is immediately rendered evident on the galvanometer. As the angle of deflection of the galvanometer indicates the power of the electric current, and as that is in exact proportion to the chemical action which originates it, it is evident that the arrangement gives an accurate measure of the chemical rays of light, at different times, from different sources, and under various circumstances" (*Athenæum*, September 21, 1839).

Tunnelling through the Alps

THE *Mechanics Magazine* of September 21, 1839, quoting from the *Mark Lane Express* said: "M. Vanino Volta, the engineer of Como, who in conjunction with M. Bruschetti of Milan, obtained in 1837, from the Austrian Government, a privilege of fifty years for the construction of a railroad between Milan and Como is now negotiating with the Swiss Cantons of Grisons and St. Gall, an enterprise which would vie in magnitude with the Thames Tunnel, viz., the piercing through the Grisons Alps. . . . M. Volta, reckoning that thirty years will be required to execute the works, demands an exclusive privilege of a hundred years with liberty to establish companies, in order to procure funds or to transfer his privileges to others."

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Scientific Proceedings of the Royal Dublin Society. Vol. 22, N.S., Nos. 15–17: Leaf Movement on Release of Sap Tension, by Prof. Henry H. Dixon; Studies in Peat, Part 6: The 'Water Phase' in Azeotropic Extraction Solvents, by J. Reilly and D. F. Kelly; Studies in Peat, Part 7: Water Distribution in Peat Wax Azeotropic Extraction Solvents, by J. Reilly, D. F. Kelly, J. Duffy and E. Coughlan. Pp. 175–194. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 2*s*. [258

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Town Planning Institute. Report on Planning for Air Raid Protection. Pp. 6. (London: Town Planning Institute.) 1*s*. [308

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U.S. Department of Agriculture. Miscellaneous Publication No. 336: The Mosquitoes of the Southeastern States. By W. V. King, G. H. Bradley and T. E. McNeel. Pp. 91. (Washington, D.C.: Government Printing Office.) 15 cents. [258

Contributions from the Biological Laboratory of the Science Society of China, Zoological Series. Vol. 12, No. 10: Oligochaeta from Hainan, Kwangtung. By Y. Chen. Pp. 375–428. Vol. 13, No. 1: On some New Gastropods from Anhui. By C. Ping. Pp. 8. Vol. 13, No. 2: Study of some Forest Insects of Nanking and its Vicinity, 2: Observations on Lappet Moth (*Metanastria ampla* Walker.) By C. P. Miao. Pp. 9–22. Vol. 13, No. 3: Dinoflagellata of the Hainan Region, 2: On the Thecal Morphology of *Blepharocysta*, with a Description of a New Species. By Da-ahu Nie. Pp. 23–42. Vol. 13, No. 4: On the Distribution of the Motor Centers on the Normal and partly Decorticated Cerebrum of the Rabbit. By C. Ping. Pp. 43–58. (Shanghai: Science Society of China.) [258

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